Alaska Fisheries Technical Report Number 68

Estimation of Adult Sockeye Salmon Escapement into Little River Lake using a Flexible Picket Weir and a Remote Video Recorder, Kodiak National Wildlife Refuge, Alaska, 2001-2003

KENNETH S. GATES and JULIE B. LAKER

U.S. Fish and Wildlife Service
Kenai Fish and Wildlife Field Office
P.O. Box 1670
Kenai, Alaska 99611

MARY A. PRICE

U.S. Fish and Wildlife Service
Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-62
Anchorage, Alaska 99501

Key words: Little River, Little River Lake, sockeye salmon, *Oncorhynchus nerka*, weir, salmon escapement, remote video recorder, Kodiak Island

This project was funded by the U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office, Kenai, Alaska.

Disclaimer

The correct citation for this report is:

Gates, K.S., J.B. Laker, and M.A. Price. 2004. Estimation of adult sockeye salmon escapement into Little River Lake using a flexible picket weir and a remote video recorder, Kodiak National Wildlife Refuge, Alaska, 2001-2003. U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office, Alaska Fisheries Technical Report Number 68, Kenai, Alaska.

Table of Contents

List of Figures

List of Appendices

Alaska Fisheries Technical Report Number 68

Estimation of Adult Sockeye Salmon Escapement into Little River Lake using a Flexible Picket Weir and Remote Video Recorder, Kodiak National Wildlife Refuge, Alaska, 2001-2003

KENNETH S. GATES and JULIE B. LAKER

U.S. Fish and Wildlife Service Kenai Fish and Wildlife Field Office
P.O. Box 1670 Kenai, Alaska 99611

MARY A. PRICE

U.S. Fish and Wildlife Service Anchorage Fish and Wildlife Field Office, 605 West 4th Avenue, Room G-62, Alaska 99501

Abstract.—A flexible picket weir and a remote video recorder were used to enumerate adult sockeye salmon *Oncorhynchus nerka* returning to Little River Lake. The weir was used during 2001, 2002, and 2003 and the remote video recorder was used during 2001 and 2002. The weir was installed by June 2 each year and operated through mid to late July. Video equipment was operated between June 13 and July 26 during 2001 and between June 4 and July 15, 2002. Information on run-timing and age, sex, and length compositions were collected at the weir site.

Sockeye salmon escapements through the weir were 4,003 (2001), 34,064 (2002), and 73,856 (2003). The number of sockeye salmon enumerated past the remote video recorder (RVR) was 36,468 (2002) between June 4 and July 3 with a weir enumeration of 30,708 during the same time period. The close proximity of the weir to RVR during 2001 caused extensive milling of fish in front of the video camera preventing any estimate of escapement. Peak weekly passage through the weir occurred during the first or second week of June each year. The number of age groups identified from sockeye salmon sampled at the weir differed among years (2001=7, 2002=9, 2003=8). The 2001 escapement was composed primarily of age 1.3 (85%) and 2.2 (11%) sockeye salmon. Age 1.2 (48%) and 3.2 (37%) sockeye salmon were dominant in 2002 and age 2.2 (76%) and 1.3 (12%) in 2003. Female sockeye salmon composed 52% to 56% of the run each year.

Introduction

The Little River watershed on Kodiak Island supports sockeye salmon *Oncohrynchus nerka*, pink salmon *O. gorbuscha*, and coho salmon *O. kisutch*. Other species documented in the Little River watershed include steelhead trout *O. mykiss* and Dolly Varden char *Salvelinus malma*. Salmon abundance in Little River has been monitored using aerial survey methods since 1968. Typically, three to seven aerial surveys were conducted each year during July and August with only a few taking place in June, September and October (Matt Foster, Alaska Department of Fish and Game, personal communication).

Since 1968, peak annual aerial counts have averaged 11,890 sockeye salmon, but have ranged as high as 50,500 fish (Appendix 1). Aerial counts serve as an index of abundance, but can be influenced by several factors including time of survey, weather conditions, water clarity and experience of the observer. Because of these influences, aerial surveys can be extremely variable among years and have minimal value for in-season management.

To gain a better understanding of run-timing and numbers of sockeye salmon returning to Little River Lake, the Kenai Fish and Wildlife Field Office (Kenai FWFO) initiated a three-year weir escapement project at the outlet of Little River Lake. A remote video recorder (RVR) was also used in conjunction with the fish counting weir. Depending upon its success, the RVR could be used as a low cost and low impact tool to estimate salmon escapement in clear water systems similar to Little River. Objectives of the project were to: (1) enumerate adult sockeye salmon returning to Little River Lake using a flexible picket weir and a RVR; (2) describe the run-timing of sockeye salmon using daily passage counts from the weir; (3) estimate weekly age and sex composition of sockeye salmon passing through the weir; (4) estimate the mean length of sockeye salmon by age and sex; and (5) test the feasibility and accuracy of the RVR. This report presents accomplishments during 2001, 2002, and 2003.

Study Area

Little River Lake is located on a peninsula between Uganik Bay and Spiridon Bay, along Shelikof Strait within Kodiak National Wildlife Refuge, Alaska (Figure 1). It is approximately 73 km west of Kodiak, Alaska. Little River Lake is a clear-water system fed by a few small tributary streams. Water levels are highly dependent on spring snowmelt and summer and fall precipitation. The lake is approximately 3.2 km long by 1.8 km wide. An isthmus is present at the northern end of the lake forming a lagoon in which water pools prior to draining into Little River. The lagoon is characterized by having little flow, grassy banks and a silty substrate.

Little River is approximately 17 km long and flows into Shelikof Strait. Its watershed is 106.2 km^2 and drains Little River Lake and several small tributary streams. Stream width ranges from 18.3 m wide at the intertidal zone to 12 m wide upstream (McCosh and Booth 1996). Riparian vegetation consists of tall grass and alders. River substrates range from medium sized gravel to boulders.

In 2001, the weir was located at the lagoon outlet. The river was approximately 12 m wide and 0.45 m deep at this location. The RVR was located 30 m below the weir in 2001 and was operated at this location during 2001 and 2002. The river was 2 m wide and 0.30 m deep at the RVR site. In 2002, the weir was moved to the junction of the lake and lagoon in order to increase the distance between the weir and the RVR. Sockeye salmon spawning was not observed in the lagoon during 2001, therefore moving the weir to this new location did not compromise weir counts. The new weir location was nine meters wide and 0.76 m deep (Figure 1). This location was used for the weir site during 2002 and 2003.

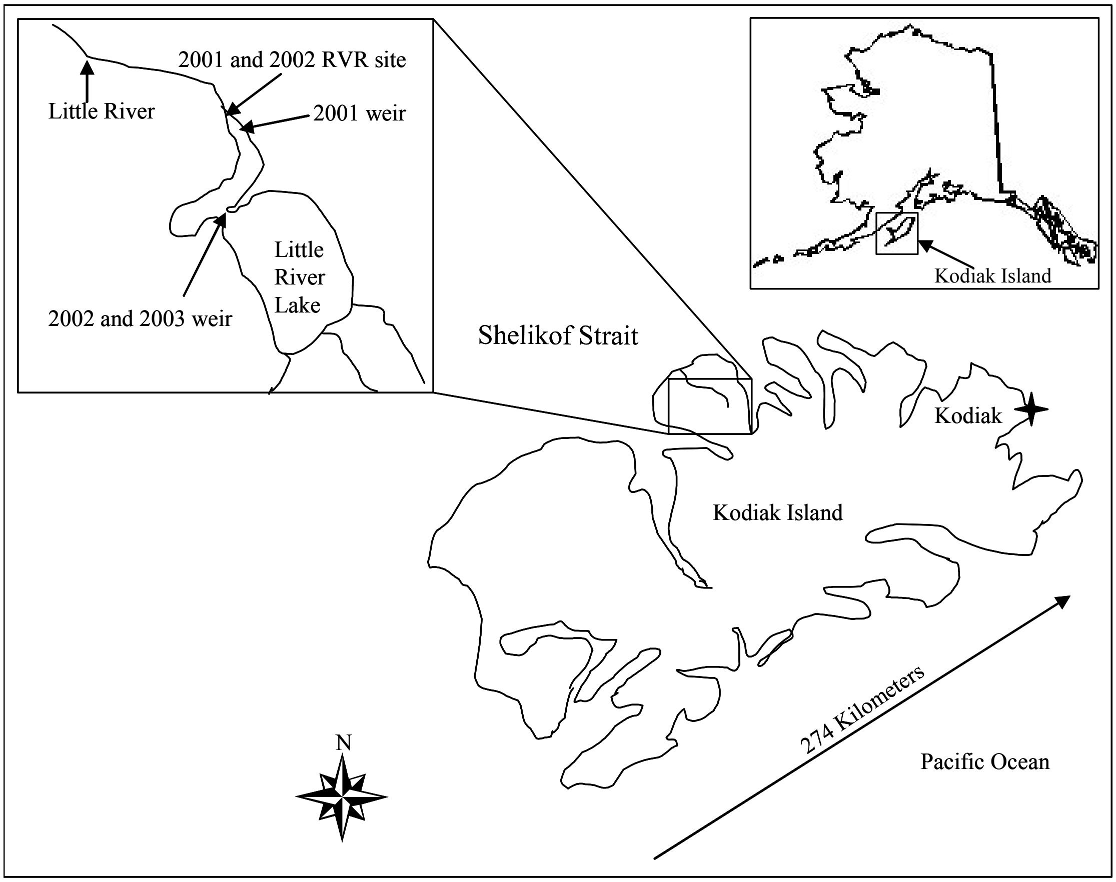


FIGURE 1.— Map of Kodiak Island showing Little River Lake and the location of the weir and RVR.

Methods

Weir Design and Operations

A flexible picket weir was installed and operated near the outlet of Little River Lake from 2001 through 2003 using methods similar to those used on McLees Lake, Unalaska Island, Alaska (Palmer 2002). Weir pickets were schedule 40 polyvinyl chloride electrical conduit with a 2.54 cm inside diameter. Picket length and spacing was 1.5 m and 3.4 cm, respectively. A trap was installed on the upstream side of the weir to allow for fish passage and sampling. In addition to the upstream trap, a passage chute was installed on the downstream side of the weir to allow for downstream movement of post-spawn steelhead kelts.

The weir was operated during daylight hours, usually 0800 hours to 2300 hours each day. Fish passing the weir were identified by species and recorded. Daily counts were relayed to the Alaska Department of Fish and Game (Department) in Kodiak to aid in the in-season management of commercial fisheries. The weir was cleaned of debris and inspected daily for damage and holes that may have developed.

Stage height and water temperature data were collected twice daily and reported as an average. Stage height measurements were collected each year; however, water temperature was measured only during 2002 and 2003 using a handheld thermometer.

Biological Sampling

Age, sex, and length (ASL) data were collected from each sampled sockeye salmon. Sample size was approximately 200 fish spread throughout the run during 2001 and 2002. Target sample size in 2003 was increased to 200 fish during each statistical week. Fish were caught using the live trap attached to the weir. A fyke gate, installed on the entrance of the trap, allowed fish to enter and at the same time minimized the number of fish exiting the trap downstream. Sampling occurred when approximately 40 fish were in the trap. One scale was extracted from each sockeye salmon for age determination. All scales were taken from the preferred area using methods described by Koo (1962) and Mosher (1968). Sex was determined by observing external characteristics and length was measured from the mid-eye to the fork (MEF) of the caudal fin to the nearest 5 mm. All data were recorded and transferred to mark-sense forms at the end of each sample day. At the end of the season, mark-sense forms and scale cards were forwarded to the Department in Kodiak to determine ages from scales and enter age data. The Department processed the mark-sense forms and provided a synopsis of the ASL data to Kenai FWFO.

Ages for salmon were reported according to the European Method (Koo 1962), where numerals preceding the decimal denote freshwater annuli and numerals following the decimal denote marine annuli. Total years of life at maturity are determined by adding one year to the sum of the two digits on either side of the decimal of the European designation (i.e., age 1.4=1+4+1=6 and 2.3=2+3+1=6 are both six-year-old fish from the same parent year). The parent year is determined by subtracting fish age from the current year.

Age and sex composition for the total escapement was estimated from the age and sex composition in the weekly sample using a stratified sampling design (Cochran 1977), with the escapement in each stratum as a weight. Estimated design effects by age, which reflect the efficiency of stratified sampling relative to simple random sampling (Skinner 1989), are presented in Appendices 4, 6, and 7. Age and sex specific escapements in a stratum, A_{hij}, and their variances, $V[A_{hij}]$, were estimated as:

$$\hat{A}_{hij} = N_h \, \hat{p}_{hij} \tag{1}$$

and

$$\hat{V}\left[\hat{A}_{hij}\right] = \hat{N}_h^2 \left(1 - \frac{n_h}{N_h}\right)\left(\frac{\hat{p}_{hij}\left(1 - \hat{p}_{hij}\right)}{n_h - 1}\right) \tag{2}$$

where

N_h = total escapement of a given species during stratum h;
$\hat{p}_{hij}$ = estimated proportion of age i and sex j fish, of a given species, in stratum h; and
n_h = total number of fish, of a given species, in the sample for stratum h.

Abundance estimates and their variances for each stratum were summed to obtain age and sex-specific escapements for the season as:

$$\hat{A}_{ij} = \sum_h \hat{A}_{hij} \tag{3}$$

and

$$\hat{V}\left[\hat{A}_{ij}\right] = \sum_h \hat{V}\left(\hat{A}_{hij}\right) \tag{4}$$

Remote Video Recorder Operations

In addition to the flexible picket weir, a RVR was installed approximately 30 m downstream from the 2001 weir site and approximately 300 m from the 2002 weir site. System design, setup and site selection were similar to those used by the Department on Port Dick Creek (Otis and Dickson 2002). The RVR was operated from 0400 to 0030 hours each day. The time-lapse videocassette recorder (TL-VCR) was protected by a large Pelican® case and then placed inside a strongbox along with four 6-volt batteries. Two battery banks, each consisting of two 6-volt batteries connected in series, provided adequate amp-hours to operate the 12-volt system. Because no trees were present, the strongbox was mounted on a 6.1 m tall aluminum quadrapod tower. The strongbox was approximately 2.4 m off the ground to prevent damage from animals. The camera was also mounted on the tower at a height of 5.5 m. Three solar panels were mounted on top of the tower to maintain power to the video system.

Videotapes were changed out every week and viewed post-season. Tapes were viewed in one-hour segments and sockeye salmon were counted using a handheld counter as they migrated upstream past the camera. Fish that were obviously smaller than sockeye salmon were regarded as Dolly Varden and not counted. At the end of each hour, the count, modal video play speed, and comments regarding video quality were recorded.

Results

Weir Operations (2001-2003)

The weir was installed and fish tight by June 2, 2001 and operated through July 26, 2001. Similarly, in 2002, the weir was installed and fish tight by May 29 and operated through July 15. The operational period during 2003 was May 29 through July 11. Although weir locations differed between the first and last two years of operation, mean water depths at the weir sites were similar during 2001 (0.38 m), 2002 (0.37 m), and 2003 (0.36 m). Mean water temperature during 2002 was 11.9 °C and ranged from 7.2 °C to

14.7 °C (Appendix 2). Temperatures during 2003 were slightly warmer with a mean water temperature of 12.9 °C and range between 7.5 °C and 19 °C (Appendix 2).

Biological Data

2001.—Sockeye salmon passed the weir between June 2 and July 26 during 2001 (Figure 2; Appendix 3). Total sockeye salmon escapement through the weir was 4,003. In addition to sockeye salmon, one steelhead kelt passed downstream through the weir on June 3. Peak weekly passage occurred between June 7 and June 13, when 1,200 (30%) sockeye salmon entered Little River Lake. The median passage date in 2001 was June 15 (Appendix 3).

Seven age groups were identified from 183 sockeye salmon sampled at the weir during 2001 (Appendix 4). The escapement was composed primarily of age 1.3 (85%) and 2.2 (11%) fish. Females made up an estimated 53% of the sockeye escapement. Sockeye salmon MEF lengths ranged from 362 mm to 612 mm for males and from 342 mm to 583 mm for females (Appendix 5).

2002.—Two species of Pacific salmon were counted through the weir between May 31 and July 15, 2002, including 34,064 sockeye and one pink salmon (Appendix 3). Other species counted through the weir included Dolly Varden (N=124) and steelhead kelts (N=17). Steelhead kelts migrated downstream past the weir between June 9 and July 7. Peak weekly passage for sockeye salmon was between June 7 and 13, when 13,620 fish (40%) passed the weir (Figure 2). The median passage for sockeye salmon during 2002 was June 12 (Appendix 3).

Nine age groups were identified in 2002 from 232 sockeye sampled at the weir (Appendix 6). Age 1.2, 3.2, and 4.2 fish were most abundant, accounting for 48%, 37%, and 9% of the sampled fish, respectively. Females made up an estimated 52% of the sockeye escapement during 2002. Sockeye salmon MEF lengths ranged from 310 mm to 571 mm for males and from 335 mm to 541 mm for females (Appendix 5).

2003.—Sockeye salmon passed the weir between May 29 and July 11 during 2003 (Appendix 3). Total sockeye salmon escapement through the weir was 73,856. Steelhead trout (N = 15) and Dolly Varden (N = 28) passed the weir throughout the duration of the project. Similar to 2002, steelhead kelts migrated downstream past the weir between May 30 and June 27. Peak weekly passage occurred between May 31 and June 6, when 29,728 (40%) sockeye salmon entered Little River Lake (Figure 2). The median passage date was June 7 (Appendix 3).

Eight age groups were identified in 2003 from 936 sockeye salmon sampled at the weir (Appendix 7). Age 1.3, 2.2, and 3.3 fish were most abundant, accounting for 12%, 76%, and 8% of the sampled fish, respectively. Females made up an estimated 56% of the sockeye escapement during 2003. Sockeye salmon MEF lengths ranged from 420 mm to 640 mm for males and from 410 mm to 610 mm for females (Appendix 5).

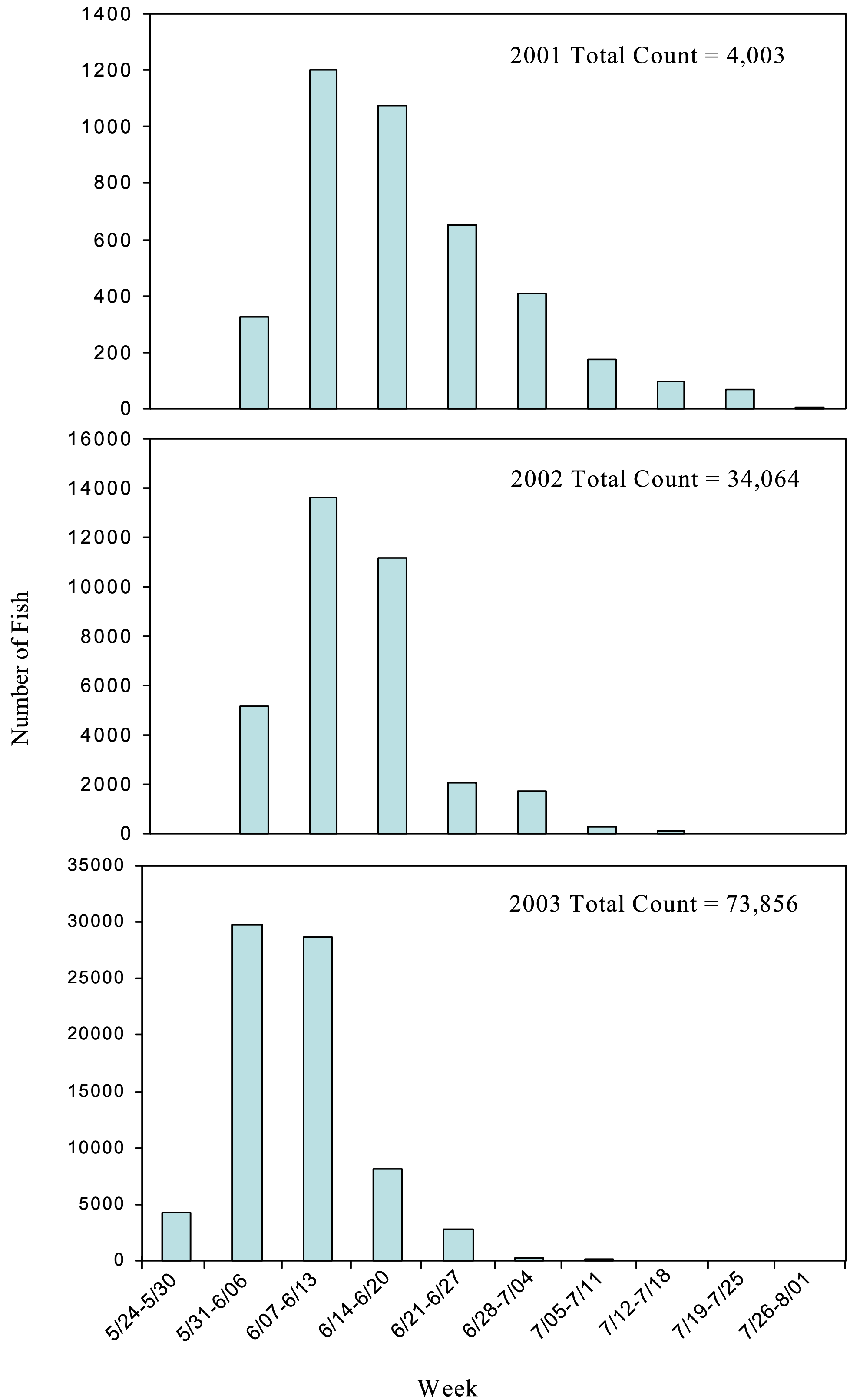


FIGURE 2. —Weekly sockeye salmon escapement through Little River weir, Kodiak Island, Alaska 2001-2003.

Remote Video Recorder Data

The RVR was operated from June 13 to July 30 during 2001 and from June 4 to July 15 during 2002. Close proximity of the weir to the RVR during 2001 caused extensive milling of fish in front of the video camera preventing any estimate of escapement. The relocation of the weir upstream during 2002 reduced milling behavior in front of the RVR allowing for an escapement estimate. Review of videotapes from June 4 through July 3 during 2002 indicated that 36,468 sockeye salmon and an undetermined number of Dolly Varden passed the RVR. Peak weekly passage of sockeye salmon (*N*=17,177) past the RVR occurred between June 14 and June 20 (Figure 3; Appendix 8). One day of video footage required 2.5 – 3.0 hours of review time. Video between July 4 and July 15 was not reviewed because data from the weir indicated that 99% of the run already had entered Little River Lake.

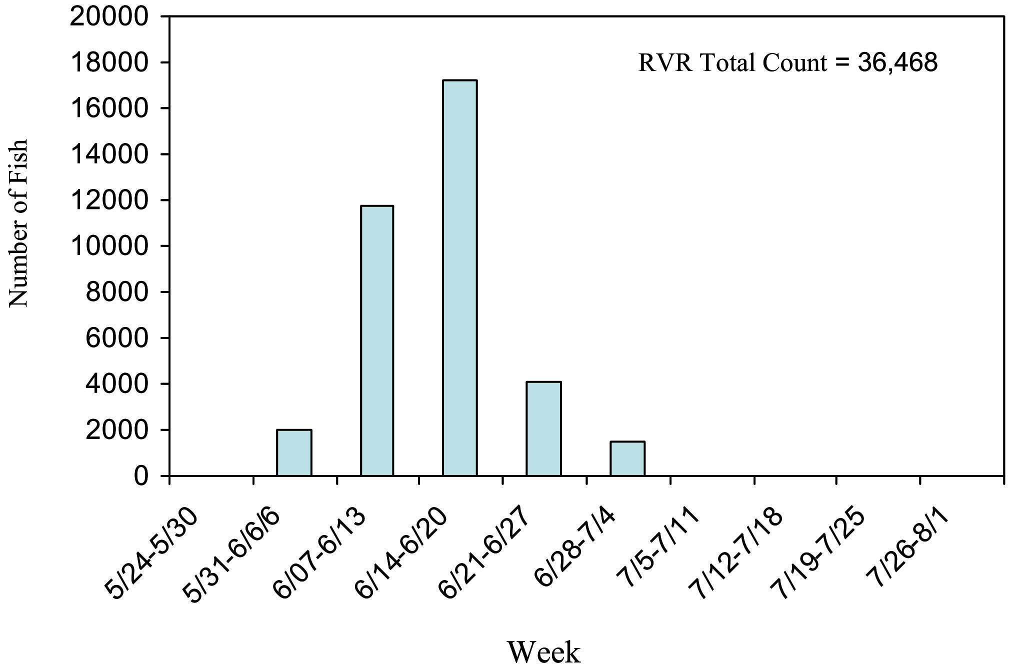


FIGURE 3.—Weekly sockeye salmon escapement passing by the RVR located at Little River Lake during 2002, Kodiak Island, Alaska.

Discussion

Weir and Remote Video Recorder Operations

The number of potential weir sites was limited to two locations, one at the isthmus between the lake and the lagoon and the second at the lagoon outlet. The weir site during 2001 was located at the lagoon outlet. This site was relatively shallow and narrow with even substrate throughout and low to moderate flow. No problems were encountered while operating the weir at this site with the exception of fish milling behind the weir and in front of the RVR. The weir was moved in 2002 to the isthmus between the lake and lagoon increasing the distance between the weir and RVR and significantly reducing the level of milling in front of the video camera.

Quality of the video obtained with the RVR during 2002 was adequate to enumerate sockeye salmon; however some limiting factors of the system were identified. Video quality was occasionally reduced by glare and shadowing from the sun and wind. Light conditions between 0030 and 0400 hours were inadequate to operate the RVR. Species identification also was difficult at times when fish passed near the bank opposite the RVR. Possible solutions to improve video quality might include using artificial lighting during the hours of darkness and moving the RVR closer to the riverbank.

Biological Data

Sockeye salmon escapements counted past the Little River weir fluctuated considerably between 2001 and 2003. Run sizes ranged from 4,003 fish in 2001 to 73,856 fish in 2003. Aerial surveys conducted by the Department on the Little River watershed have shown similar fluctuations, with counts ranging from 2,700 fish in 2001 to 50,500 fish in 2003 (Appendix 1). Prior to 2001, aerial survey counts ranged from 130 in 1971 to 35,500 in 1980. Year to year fluctuations in run strength appear to be characteristic of sockeye salmon returning to Little River Lake.

Run-timing at the weir was different among years. Median passage dates ranged from June 7 in 2003 to June 15 in 2001 (Figure 4; Appendix 3). The weir was installed four days later during 2001 than in 2002 and 2003. The later installation could have affected the median passage date during 2001, but this scenario is unlikely considering the small numbers of fish passing the weir during the first week of operation.

Sockeye salmon age compositions sampled between 2001 and 2003 were primarily derived from the 1995, 1996 and 1998 brood years (Figure 5). Recruits from the 1997 brood year represented less than 1.5% of fish sampled annually between 2001 and 2003 (Figure 5). Poor freshwater and or saltwater survival may be the cause of weak returns from the 1997 brood year. In Karluk Lake located 50 km southwest of Little River Lake, recruitment from the 1997 brood year ranged from 3.7% (2001) to approximately 39.1% (2002) during the early run (Matt Foster, Alaska Department of Fish and Game, personal communication). Assuming that sockeye salmon from Karluk and Little River Lakes experience similar ocean conditions, low 1997 brood year recruitment into Little River Lake may be attributed to poor freshwater survival.

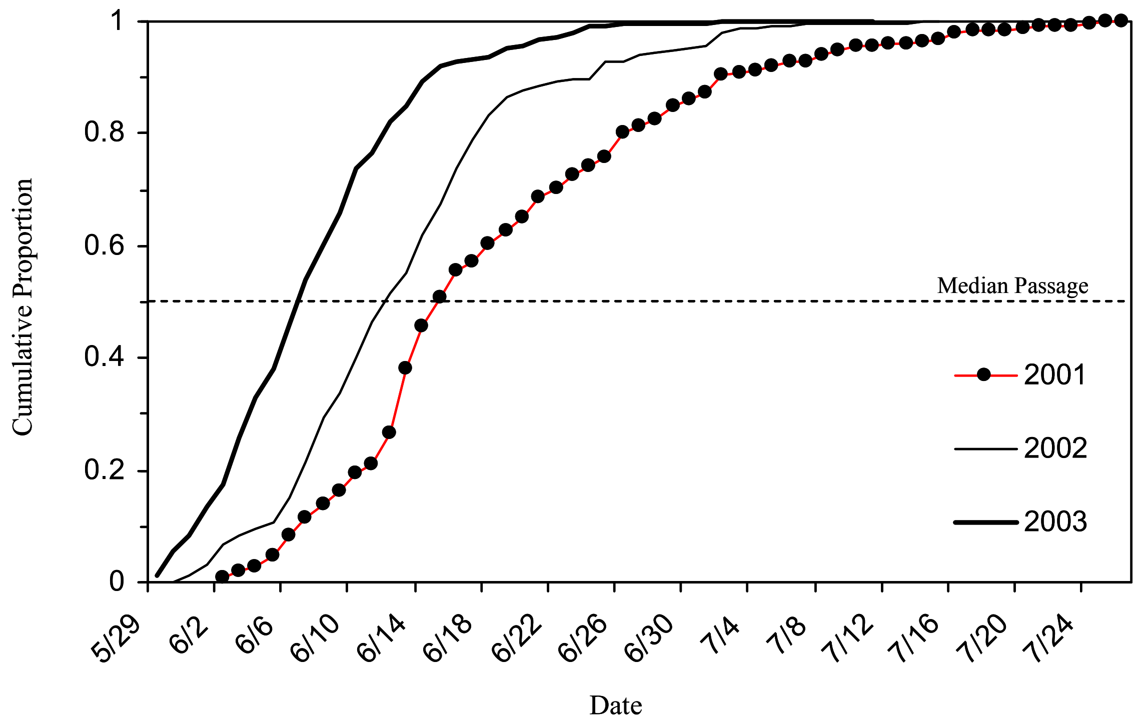


FIGURE 4.—Cumulative proportion passage of sockeye salmon through the Little River weir, Kodiak Island, Alaska, 2001-2003.

Survival can be influenced during freshwater life stages by several factors including lake productivity, competition for food and space, and predation. Competition for resources can affect survival when multiple year classes and/or large year classes are present or when different species utilize the same resources (Burgner 1991). Freshwater ages identified from the Little River weir sample ranged from zero to four years, illustrating that multiple year classes did exist in the lake. However, this does not directly indicate that competition was occurring, because competition only exists if the resources are in a short supply or if the fish seeking the resources harm one another in the process (Birch1957). Longer freshwater residencies experienced by age 4.2 (9%) and 4.3 (2.5%) fish may indicate that Little River Lake productivity is low at times resulting in greater competition for food and prolonged freshwater residence. Age 4.2 and 4.3 fish are uncommon on Kodiak Island and have only been observed in Karluk Lake (<0.5%) between 2001 and 2003 (Matt Foster, Alaska Department of Fish and Game, personal communication).

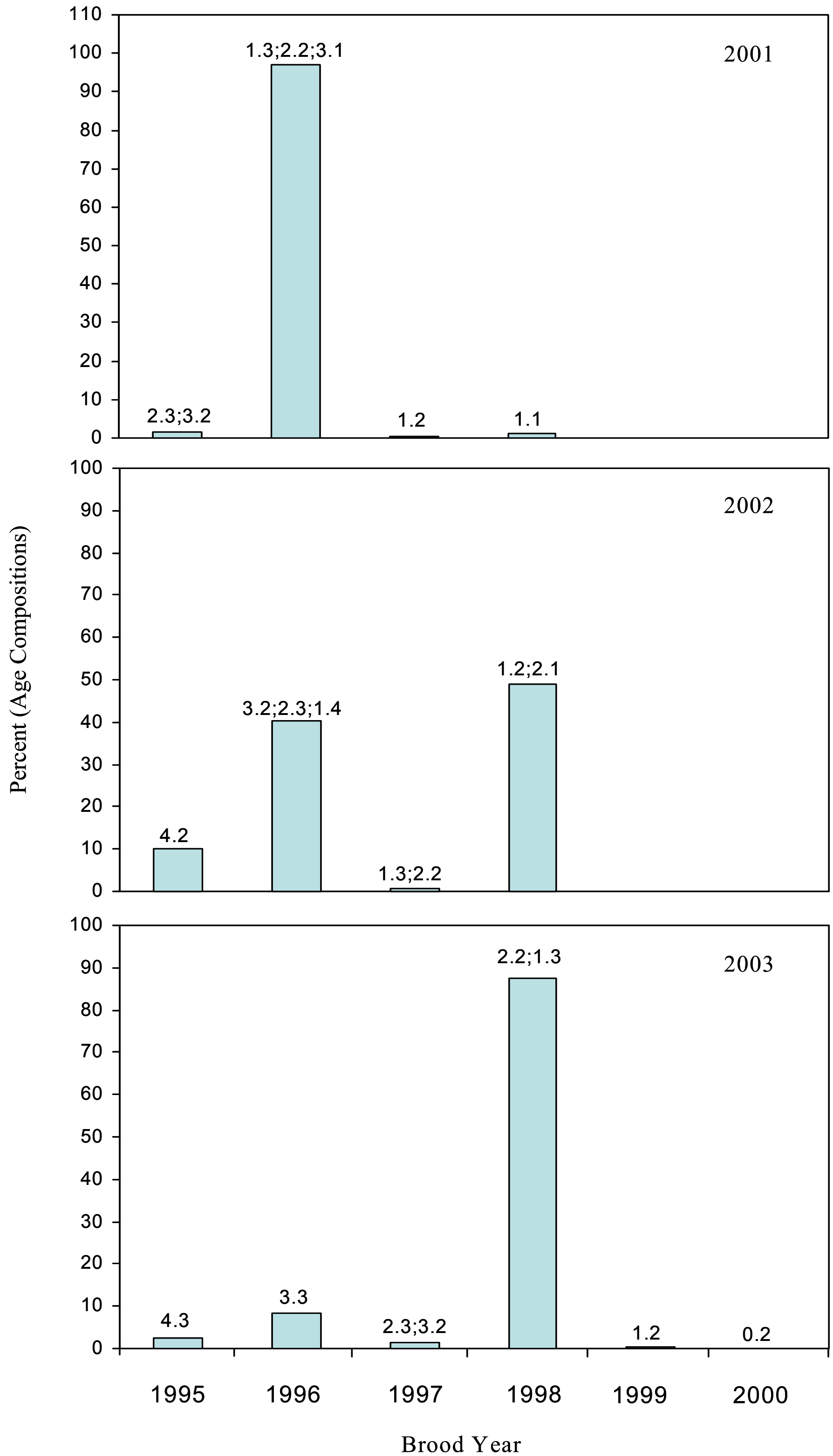


FIGURE 5.—Percent age compositions and brood year contributions of sockeye salmon to Little River Lake, Kodiak Island, Alaska during 2001-2003.

Weir and Remote Video Recorder Comparison

Sockeye salmon counted from June 4 to July 3 using the RVR exceeded weir counts by 5,760 fish. Initially, cumulative escapement using the RVR was less than the weir counts, but after June 15 the RVR cumulative escapement exceeded weir counts for the remainder of the season (Figure 6; Appendix 8). Identification and enumeration of fish were subjective and observer dependent during weir and video counts and may have contributed to the difference in the counts. Several possibilities associated with this include (1) misidentifying Dolly Varden as sockeye salmon during video review, (2) overestimating large sockeye salmon groups passing the RVR, (3) enumerating individual sockeye salmon multiple times as they milled in front of the RVR; and (4) underestimating sockeye salmon counts at the weir during peak passage times.

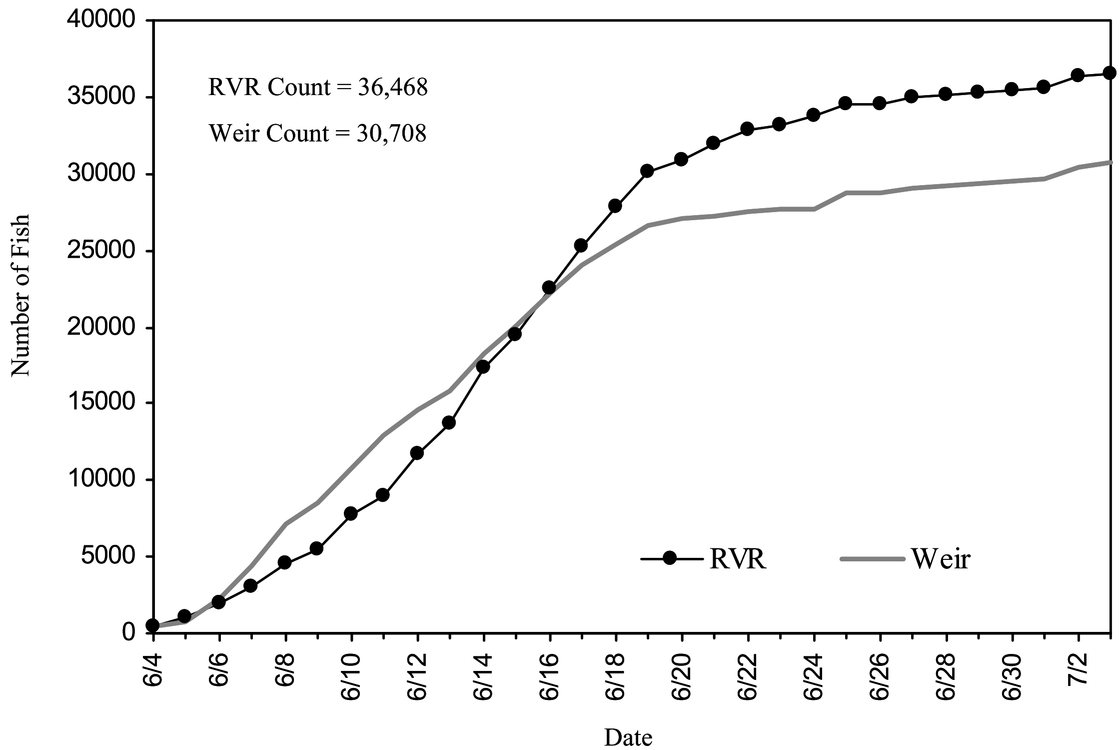


FIGURE 6.—Comparison of cumulative counts of sockeye salmon passing through the Little River weir and by the RVR between June 4 and July 3, 2002, Kodiak Island, Alaska.

In conclusion, sockeye salmon returning to Little River Lake can be enumerated using a flexible picket weir or a RVR. Each method of enumeration provides a more accurate means of estimating escapement than conventional aerial surveys. When comparing the utility of the Little River weir and the RVR, the weir is a more useful tool for in-season management because data can be relayed to managers immediately, whereas time delays and high costs would be associated with retrieving and reviewing RVR escapement information. The RVR is a more useful tool for acquiring escapement estimates of fish, in systems similar to Little River, that require more accurate estimates of escapement than aerial surveys or for establishing a baseline of information.

Information gathered between 2001 and 2003 suggests that sockeye salmon returns to Little River Lake can fluctuate greatly. Based on aerial survey and weir counts, the sockeye salmon return during 2003 may have been the largest escapement to return to Little River Lake in the past 35 years. We currently do not have a complete understanding of all the mechanisms that may have influenced the survival of progeny from the 1997 brood year, however, based on age composition information, we can speculate that lake productivity in Little River Lake might be a limiting factor. Continued monitoring with a weir or RVR, collection of basic limnological information, and additional sampling for age compositions would provide a better understanding of run cycles, recruitment, age compositions, and lake productivity associated with the Little River Lake. Continued monitoring also would provide area managers with timely and accurate data needed to manage commercial sockeye salmon fisheries around Kodiak Island, Alaska.

Acknowledgements

Special appreciation is extended to Elyse Williams, Mike Castle, Rabecca Smith, Kara Krumenauer, Kelly Harbin, and Laurie Stafford for their hard work and dedication at the Little River weir. The Kodiak National Wildlife Refuge provided aerial support for the project and living quarters while in Kodiak.

We would also like to thank Matt Foster and staff from Alaska Department of Fish and Game, Commercial Fisheries Division located in Kodiak, Alaska for scale sample analysis.

References

Birch, L.C. 1957. The meaning of competition. Am. Nat. 91:5-18 *in* R.L Burgner. 1991. Life history of sockeye salmon (*Oncorhynchus nerka*). Pages 3-117 *in* Groot, C. and L. Margolis, editors. Pacific salmon life histories. UBC Press, University of British Columbia, Vancouver, British Columbia.

Burgner, R.L. 1991. Life history of sockeye salmon (*Oncorhynchus nerka*). Pages 3-117 *in* Groot, C. and L. Margolis, editors. Pacific salmon life histories. UBC Press, University of British Columbia, Vancouver, British Columbia.

Cochran, W.G. 1977. Sampling Techniques, 3rd edition. John Wiley & Sons, New York.

Koo, T.S.Y. 1962. Age determination in salmon. Pages 37-48 *in* T.S.Y. Koo, editor. Studies of Alaskan red salmon. University of Washington Press, Seattle, Washington.

McCosh, M.L. and J.A. Booth. 1996. Age and length characteristics of rainbow trout from Dog Salmon, Little and Uganik rivers on the Kodiak National Wildlife Refuge, Alaska, 1995. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Progress Report 96-3, Kenai, Alaska.

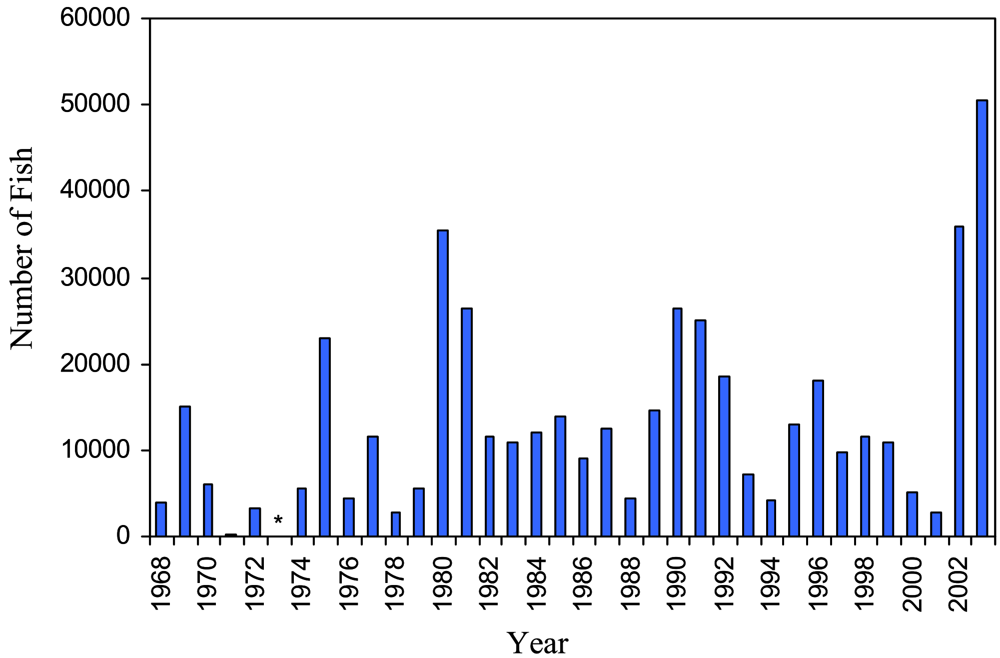
Mosher, K.H. 1968. Photographic atlas of sockeye salmon scales. U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Bulletin No. 2:243-274.

Otis, E.O., and M. Dickson. 2002. Improved salmon escapement enumeration using remote video and time-lapse recording technology, Exxon Valdez Oil Spill Restoration Project. Final Report (Restoration Project 00366), Alaska Department of Fish and Game, Division of Commercial Fisheries, Homer, Alaska.

Palmer, D.E. 2002. Estimation of sockeye salmon escapement into McLees Lake, Unalaska Island, 2001. U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office, Alaska Fisheries Data Series Number 2002-2, Kenai, Alaska.

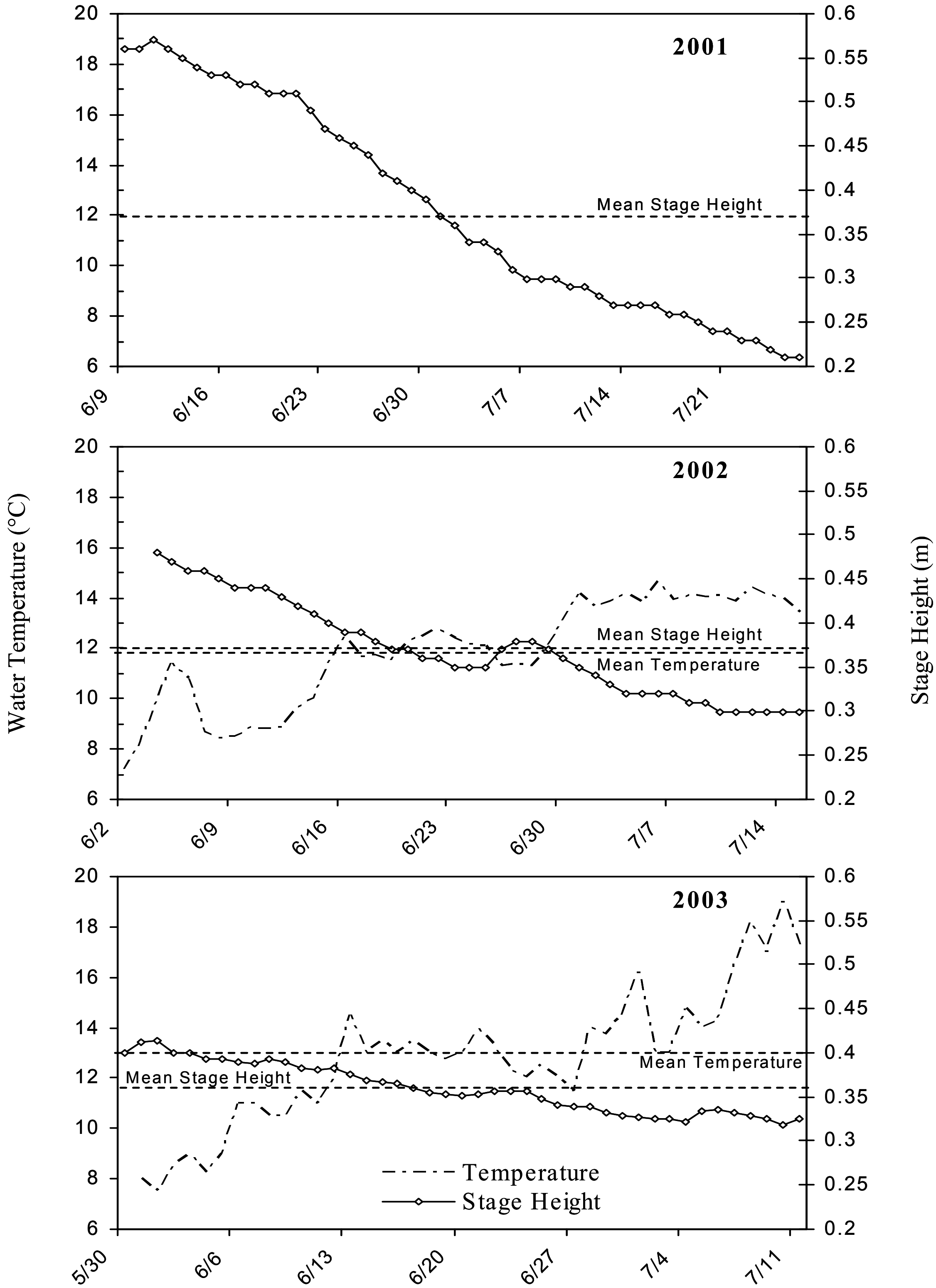
Skinner, C. J. 1989. Introduction to Part A. Pages 23-58 in Skinner, C. J., Holt, D., and Smith, T. M. F., editors. Analysis of Complex Surveys. John Wiley & Sons, New York.

Appendices



* Sockeye salmon were reported in Little River Lake during two surveys conducted on July 18 and August 30, 1973 but they were not enumerated.

APPENDIX 1.—Peak aerial counts of sockeye salmon for Little River watershed, Kodiak Island, Alaska, 1968-2003.



APPENDIX 2.— Average daily water temperatures and water depths at Little River weir, Kodiak Island, Alaska, 2001-2003. Water temperature was not collected during 2001.

APPENDIX 3.—Daily counts, cumulative counts, and cumulative proportion of sockeye salmon escapement through the Little River weir, Kodiak Island, Alaska, 2001-2003. Boxed areas encompass the second quartile, median, and third quartile of the sockeye salmon escapement.

	2001			2002			2003		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
5/29				0	0	0.0000	806	806	0.0109
5/30				0	0	0.0000	3441	4247	0.0575
5/31				340	340	0.0100	1882	6129	0.0830
6/1				805	1145	0.0336	3938	10067	0.1363
6/2	24	24	0.0060	1099	2244	0.0659	2756	12823	0.1736
6/3	50	74	0.0185	654	2898	0.0851	6357	19180	0.2597
6/4	36	110	0.0275	410	3308	0.0971	5270	24450	0.3310
6/5	79	189	0.0472	376	3684	0.1081	3540	27990	0.3790
6/6	137	326	0.0814	1470	5154	0.1513	5985	33975	0.4600
6/7	131	457	0.1142	2128	7282	0.2138	5966	39941	0.5408
6/8	97	554	0.1384	2773	10055	0.2952	4740	44681	0.6050
6/9	100	654	0.1634	1387	11442	0.3359	4086	48767	0.6603
6/10	122	776	0.1939	2200	13642	0.4005	5874	54641	0.7398
6/11	70	846	0.2113	2208	15850	0.4653	1821	56462	0.7645
6/12	218	1064	0.2658	1684	17534	0.5147	4318	60780	0.8230
6/13	462	1526	0.3812	1240	18774	0.5511	1830	62610	0.8477
6/14	299	1825	0.4559	2366	21140	0.6206	3230	65840	0.8915
6/15	203	2028	0.5066	1880	23020	0.6758	2174	68014	0.9209
6/16	191	2219	0.5543	2104	25124	0.7376	494	68508	0.9276
6/17	72	2291	0.5723	1736	26860	0.7885	317	68825	0.9319
6/18	131	2422	0.6050	1467	28327	0.8316	442	69267	0.9379
6/19	85	2507	0.6263	1144	29471	0.8652	929	70196	0.9504
6/20	94	2601	0.6498	460	29931	0.8787	556	70752	0.9580
6/21	140	2741	0.6847	191	30122	0.8843	753	71505	0.9682
6/22	76	2817	0.7037	281	30403	0.8925	393	71898	0.9735
6/23	87	2904	0.7255	128	30531	0.8963	354	72252	0.9783
6/24	66	2970	0.7419	54	30585	0.8979	886	73138	0.9903
6/25	61	3031	0.7572	1001	31586	0.9273	231	73369	0.9934
6/26	174	3205	0.8006	89	31675	0.9299	75	73444	0.9944
6/27	48	3253	0.8126	317	31992	0.9392	122	73566	0.9961
6/28	44	3297	0.8236	158	32150	0.9438	0	73566	0.9961
6/29	96	3393	0.8476	93	32243	0.9465	122	73688	0.9977
6/30	57	3450	0.8619	228	32471	0.9532	7	73695	0.9978
7/1	38	3488	0.8713	145	32616	0.9575	5	73700	0.9979
7/2	130	3618	0.9038	731	33347	0.9790	50	73750	0.9986
7/3	19	3637	0.9086	259	33606	0.9866	12	73762	0.9987
7/4	22	3659	0.9141	88	33694	0.9891	7	73769	0.9988
7/5	31	3690	0.9218	94	33788	0.9919	13	73782	0.9990
7/6	21	3711	0.9271	26	33814	0.9927	12	73794	0.9992
7/7	12	3723	0.9301	69	33883	0.9947	3	73797	0.9992
7/8	35	3758	0.9388	23	33906	0.9954	13	73810	0.9994
7/9	41	3799	0.9490	12	33918	0.9957	29	73839	0.9998
7/10	25	3824	0.9553	20	33938	0.9963	5	73844	0.9998
7/11	10	3834	0.9578	16	33954	0.9968	12	73856	1.0000
7/12	9	3843	0.9600	12	33966	0.9971			
7/13	3	3846	0.9608	17	33983	0.9976			
7/14	18	3864	0.9653	20	34003	0.9982			
7/15	17	3881	0.9695	61	34064	1.0000			
7/16	38	3919	0.9790						
7/17	13	3932	0.9823						
7/18	0	3932	0.9823						
7/19	4	3936	0.9833						
7/20	17	3953	0.9875						
7/21	14	3967	0.9910						
7/22	3	3970	0.9918						
7/23	7	3977	0.9935						
7/24	12	3989	0.9965						
7/25	9	3998	0.9988						
7/26	5	4003	1.0000						

APPENDIX 4.—Estimated age and sex composition of sockeye salmon passing the Little River weir, Kodiak Island, Alaska, 2001.

		Brood Year and Age Group							
		1998	1997	1996			1995		
		1.1	1.2	1.3	2.2	3.1	2.3	3.2	Total
Stratum 1: 05/31-06/13[a]									
Sampling Dates: 06/08,06/09,06/10									
Female:	Number in Sample:	0	0	12	0	0	0	0	12
	Estimated % of Escapement:	0.0	0.0	50.0	0.0	0.0	0.0	0.0	50.0
	Estimated Escapement:	0	0	763	0	0	0	0	763
	Standard Error:	0.0	0.0	157.8	0.0	0.0	0.0	0.0	
Male:	Number in Sample:	0	0	11	1	0	0	0	12
	Estimated % of Escapement:	0.0	0.0	45.8	4.2	0.0	0.0	0.0	50.0
	Estimated Escapement:	0	0	699	64	0	0	0	763
	Standard Error:	0.0	0.0	157.3	63.1	0.0	0.0	0.0	
Total:	Number in Sample:	0	0	23	1	0	0	0	24
	Estimated % of Escapement:	0.0	0.0	95.8	4.2	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	0	1,462	64	0	0	0	1,526
	Standard Error:	0.0	0.0	63.1	63.1	0.0	0.0	0.0	
Stratum 2: 06/14-06/20									
Sampling Dates: 06/14,06/15,06/16,06/17, & 06/20									
Female:	Number in Sample:	1	0	16	2	1	0	0	20
	Estimated % of Escapement:	2.6	0.0	42.1	5.3	2.6	0.0	0.0	52.6
	Estimated Escapement:	28	0	453	57	28	0	0	566
	Standard Error:	27.8	0.0	85.7	38.8	27.8	0.0	0.0	
Male:	Number in Sample:	0	0	15	2	0	1	0	18
	Estimated % of Escapement:	0.0	0.0	39.5	5.3	0.0	2.6	0.0	47.4
	Estimated Escapement:	0	0	424	57	0	28	0	509
	Standard Error:	0.0	0.0	84.8	38.8	0.0	27.8	0.0	
Total:	Number in Sample:	1	0	31	4	1	1	0	38
	Estimated % of Escapement:	2.6	0.0	81.6	10.5	2.6	2.6	0.0	100.0
	Estimated Escapement:	28	0	877	113	28	28	0	1,075
	Standard Error:	27.8	0.0	67.3	53.3	27.8	27.8	0.0	
Stratum 3: 06/21-06-27									
Sampling Dates: 06/22, & 06/25									
Female:	Number in Sample:	0	0	16	4	1	1	0	22
	Estimated % of Escapement:	0.0	0.0	44.4	11.1	2.8	2.8	0.0	61.1
	Estimated Escapement:	0	0	290	72	18	18	0	398
	Standard Error:	0.0	0.0	53.2	33.7	17.6	17.6	0.0	
Male:	Number in Sample:	0	0	12	2	0	0	0	14
	Estimated % of Escapement:	0.0	0.0	33.3	5.6	0.0	0.0	0.0	38.9
	Estimated Escapement:	0	0	217	36	0	0	0	254
	Standard Error:	0.0	0.0	50.5	24.5	0.0	0.0	0.0	
Total:	Number in Sample:	0	0	28	6	1	1	0	36
	Estimated % of Escapement:	0.0	0.0	77.8	16.7	2.8	2.8	0.0	100.0
	Estimated Escapement:	0	0	507	109	18	18	0	652
	Standard Error:	0.0	0.0	44.5	39.9	17.6	17.6	0.0	

-continued-

APPENDIX 4.—(Page 2 of 3)

		Brood Year and Age Group							
		1998	1997	1996			1995		
		1.1	1.2	1.3	2.2	3.1	2.3	3.2	Total
Stratum 4: 06/28-07/04									
Sampling Dates: 06/28,06/29, & 07/02									
Female:	Number in Sample:	0	0	8	2	0	0	0	10
	Estimated % of Escapement:	0.0	0.0	47.1	11.8	0.0	0.0	0.0	58.8
	Estimated Escapement:	0	0	191	48	0	0	0	239
	Standard Error:	0.0	0.0	49.6	32.0	0.0	0.0	0.0	
Male:	Number in Sample:	0	0	6	1	0	0	0	7
	Estimated % of Escapement:	0.0	0.0	35.3	5.9	0.0	0.0	0.0	41.2
	Estimated Escapement:	0	0	143	24	0	0	0	167
	Standard Error:	0.0	0.0	47.5	23.4	0.0	0.0	0.0	
Total:	Number in Sample:	0	0	14	3	0	0	0	17
	Estimated % of Escapement:	0.0	0.0	82.4	17.6	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	0	334	72	0	0	0	406
	Standard Error:	0.0	0.0	37.9	37.9	0.0	0.0	0.0	
Stratum 5: 07/05-07/11									
Sampling Dates: 07/06,07/07,07/08, & 07/09									
Female:	Number in Sample:	0	0	3	2	0	1	0	6
	Estimated % of Escapement:	0.0	0.0	17.6	11.8	0.0	5.9	0.0	35.3
	Estimated Escapement:	0	0	31	21	0	10	0	62
	Standard Error:	0.0	0.0	15.8	13.4	0.0	9.8	0.0	
Male:	Number in Sample:	1	1	6	3	0	0	0	11
	Estimated % of Escapement:	5.9	5.9	35.3	17.6	0.0	0.0	0.0	64.7
	Estimated Escapement:	10	10	62	31	0	0	0	113
	Standard Error:	9.8	9.8	19.9	15.8	0.0	0.0	0.0	
Total:	Number in Sample:	1	1	9	5	0	1	0	17
	Estimated % of Escapement:	5.9	5.9	52.9	29.4	0.0	5.9	0.0	100.0
	Estimated Escapement:	10	10	93	51	0	10	0	175
	Standard Error:	9.8	9.8	20.7	18.9	0.0	9.8	0.0	
Stratum 6: 07/12-07/18									
Sampling Dates: 07/14, 07/15, 07/16, & 07/17									
Female:	Number in Sample:	0	0	13	2	0	0	0	15
	Estimated % of Escapement:	0.0	0.0	56.5	8.7	0.0	0.0	0.0	65.2
	Estimated Escapement:	0	0	55	9	0	0	0	64
	Standard Error:	0.0	0.0	9.1	5.2	0.0	0.0	0.0	
Male:	Number in Sample:	0	1	6	1	0	0	0	8
	Estimated % of Escapement:	0.0	4.3	26.1	4.3	0.0	0.0	0.0	34.8
	Estimated Escapement:	0	4	26	4	0	0	0	34
	Standard Error:	0.0	3.7	8.0	3.7	0.0	0.0	0.0	
Total:	Number in Sample:	0	1	19	3	0	0	0	23
	Estimated % of Escapement:	0.0	4.3	82.6	13.0	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	4	81	13	0	0	0	98
	Standard Error:	0.0	3.7	6.9	6.2	0.0	0.0	0.0	

-continue-

APPENDIX 4.—(Page 3 of 3)

		Brood Year and Age Group							
		1998	1997	1996			1995		
		1.1	1.2	1.3	2.2	3.1	2.3	3.2	Total
Stratum 7: 07/19-07/25[b]									
Sampling Dates: 07/20, 07/21, 07/22, 07/23 & 07/24									
Female:	Number in Sample:	0	1	13	2	1	1	1	19
	Estimated % of Escapement:	0.0	3.4	44.8	6.9	3.4	3.4	3.4	65.5
	Estimated Escapement:	0	2	32	5	2	2	2	47
	Standard Error:	0.0	1.9	5.1	2.6	1.9	1.9	1.9	
Male:	Number in Sample:	0	2	5	2	0	1	0	10
	Estimated % of Escapement:	0.0	6.9	17.2	6.9	0.0	3.4	0.0	34.5
	Estimated Escapement:	0	5	12	5	0	2	0	24
	Standard Error:	0.0	2.6	3.9	2.6	0.0	1.9	0.0	
Total:	Number in Sample:	0	3	18	4	1	2	1	29
	Estimated % of Escapement:	0.0	10.3	62.1	13.8	3.4	6.9	3.4	100.0
	Estimated Escapement:	0	7	44	10	2	5	2	71
	Standard Error:	0.0	3.1	5.0	3.6	1.9	2.6	1.9	
Strata 1 - 7: 5/31-7/25									
Female:	Number in Sample:	1	1	81	14	3	3	1	104
	% Females in Age Group:	1.3	0.1	84.9	9.9	2.3	1.4	0.1	100.0
	Estimated % of Escapement:	0.7	0.1	45.3	5.3	1.2	0.8	0.1	53.4
	Estimated Escapement:	28	2	1,815	211	49	31	2	2,138
	Standard Error:	27.8	1.9	194.7	62.2	32.9	20.2	1.9	
	Estimated Design Effects:	1.302	0.112	1.794	0.932	1.075	0.657	0.112	1.793
Male:	Number in Sample:	1	4	61	12	0	2	0	80
	% Males in Age Group:	0.6	1.0	84.9	11.8	0.0	1.6	0.0	100.0
	Estimated % of Escapement:	0.3	0.5	39.6	5.5	0.0	0.8	0.0	46.6
	Estimated Escapement:	10	19	1,584	220	0	31	0	1,865
	Standard Error:	9.8	10.8	192.9	83.1	0.0	27.8	0.0	
	Estimated Design Effects:	0.472	0.320	1.824	1.563	0.000	1.208	0.000	1.793
Total:	Number in Sample:	2	5	142	26	3	5	1	184
	Estimated % of Escapement:	1.0	0.5	84.9	10.8	1.2	1.5	0.1	100.0
	Estimated Escapement:	39	22	3,399	431	49	62	2	4,003
	Standard Error:	29.5	10.9	111.5	101.3	32.9	34.4	1.9	
	Estimated Design Effects:	1.084	0.296	1.150	1.264	1.075	0.939	0.112	

[a] Strata 1 includes escapement between 6/02 and 6/05 (N=186)

[b] Strata 7 includes escapement on 7/26 (N=5)

APPENDIX 5.—Length at age for sockeye salmon sampled at Little River weir, 2001-2003, Kodiak Island, Alaska.

	Age													
	0.2	1.1	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	3.3	4.2	4.3	Total
2001														
Females														
Mean Length	–	362	523	–	537	474	393	–	517	408	–	–	–	519
SE	–	–	–	–	2	8	4	–	14	–	–	–	–	4
Range	–	–	–	–	491-583	413-502	385-397	–	499-544	–	–	–	–	342-583
Sample Size	–	1	1	–	80[b]	13	3	–	3	1	–	–	–	140[a,b]
Male														
Mean Length	–	362	495	–	556	493	–	–	554	–	–	–	–	542
SE	–	–	33	–	4	12	–	–	4	–	–	–	–	5
Range	–	–	419-568	–	493-612	411-589	–	–	550-557	–	–	–	–	362-612
Sample Size	–	1	4	–	61	12	–	–	2	–	–	–	–	99[a]
All Fish														
Mean Length	–	362	501	–	545	483	393	–	532	408	–	–	–	529
SE	–	0	26	–	2	7	4	–	12	–	–	–	–	3
Range	–	362-362	419-568	–	491-612	411-589	385-397	–	499-557	–	–	–	–	342-612
Sample Size	–	2	5	–	141	25	3	–	5	1	–	–	–	239[a,b]
2002														
Females														
Mean Length	–	–	470	381	–	486	–	–	495	477	535	475	–	472
SE	–	–	3	–	–	–	–	–	–	3	–	8	–	2
Range	–	–	419-519	–	–	–	–	–	–	418-520	–	434-507	–	335-541
Sample Size	–	–	76	1	–	1	–	–	1	38	1	9	–	137[a]
Male														
Mean Length	–	–	476	381	510	461	–	509	567	471	–	482	–	465
SE	–	–	5	13	–	–	–	–	4	8	–	18	–	5
Range	–	–	385-539	310-480	–	–	–	–	563-571	383-544	–	410-535	–	310-571
Sample Size	–	–	50	12	1	1	–	1	2	31	–	7	–	116[a]
All Fish														
Mean Length	–	–	473	381	510	474	–	509	543	474	535	479	–	469
SE	–	–	3	12	–	13	–	–	24	4	–	9	–	3
Range	–	–	385-539	310-480	–	461-486	–	–	495-571	383-544	–	410-535	–	310-571
Sample Size	–	–	126	13	1	2	–	1	3	69	1	16	–	253[a]
2003														
Females														
Mean Length	–	–	600	–	539	497	–	–	555	488	524	–	551	503
SE	–	–	–	–	3	1	–	–	45	2	5	–	9	1
Range	–	–	–	–	480-575	410-610	–	–	510-600	485-490	480-600	–	520-610	410-610
Sample Size	–	–	1	–	47	442	–	–	2	3	24	–	9	587[a]
Male														
Mean Length	445	–	563	–	559	514	–	–	543	448	542	–	530	520
SE	–	–	78	–	7	2	–	–	33	13	6	–	9	2
Range	–	–	485-640	–	480-625	420-605	–	–	510-575	435-460	480-640	–	495-565	420-640
Sample Size	1	–	2	–	35	329	–	–	2	2	29	–	8	465[a]
All Fish														
Mean Length	445	–	445	–	547	504	–	–	549	472	534	–	541	510
SE	–	–	0	–	4	1	–	–	23	11	4	–	7	1
Range	–	–	445-445	–	480-625	410-610	–	–	510-600	435-490	480-640	–	495-610	410-640
Sample Size	1	–	3	–	82	771	–	–	4	5	53	–	17	1052[a]

[a] Includes fish that did not have an age association.

[b] Total excludes one age 1.3 female without a length association.

APPENDIX 6.—Estimated age and sex composition of sockeye salmon passing the Little River weir, Kodiak Island, Alaska, 2002.

		Brood Year and Age Group									
		1998		1997		1996			1995		
		1.2	2.1	1.3	2.2	1.4	2.3	3.2	3.3	4.2	Total
Stratum 1: 5/31-06/06											
Sampling Dates: 5/31, 06/04, 06/06											
Female:	Number in Sample:	0	0	0	0	0	1	8	0	0	9
	Estimated % of Escapement:	0.0	0.0	0.0	0.0	0.0	3.2	25.8	0.0	0.0	29.0
	Estimated Escapement:	0	0	0	0	0	166	1,330	0	0	1,496
	Standard Error:	0.0	0.0	0.0	0.0	0.0	165.8	410.5	0.0	0.0	
Male:	Number in Sample:	4	0	1	0	1	0	14	0	2	22
	Estimated % of Escapement:	12.9	0.0	3.2	0.0	3.2	0.0	45.2	0.0	6.5	71.0
	Estimated Escapement:	665	0	166	0	166	0	2,328	0	333	3,658
	Standard Error:	314.5	0.0	165.8	0.0	165.8	0.0	466.9	0.0	230.5	
Total:	Number in Sample:	4	0	1	0	1	1	22	0	2	31
	Estimated % of Escapement:	12.9	0.0	3.2	0.0	3.2	3.2	71.0	0.0	6.5	100.0
	Estimated Escapement:	665	0	166	0	166	166	3,658	0	333	5,154
	Standard Error:	314.5	0.0	165.8	0.0	165.8	165.8	425.8	0.0	230.5	
Stratum 2: 06/07-06/13											
Sampling Dates: 06/08,06/10,06/12											
Female:	Number in Sample:	13	0	0	0	0	0	10	0	2	25
	Estimated % of Escapement:	28.9	0.0	0.0	0.0	0.0	0.0	22.2	0.0	4.4	55.6
	Estimated Escapement:	3,935	0	0	0	0	0	3,027	0	605	7,567
	Standard Error:	929.1	0.0	0.0	0.0	0.0	0.0	852.2	0.0	422.4	
Male:	Number in Sample:	7	0	0	0	0	1	10	0	2	20
	Estimated % of Escapement:	15.6	0.0	0.0	0.0	0.0	2.2	22.2	0.0	4.4	44.4
	Estimated Escapement:	2,119	0	0	0	0	303	3,027	0	605	6,053
	Standard Error:	743.0	0.0	0.0	0.0	0.0	302.2	852.2	0.0	422.4	
Total:	Number in Sample:	20	0	0	0	0	1	20	0	4	45
	Estimated % of Escapement:	44.4	0.0	0.0	0.0	0.0	2.2	44.4	0.0	8.9	100.0
	Estimated Escapement:	6,053	0	0	0	0	303	6,053	0	1,211	13,620
	Standard Error:	1,018.6	0.0	0.0	0.0	0.0	302.2	1,018.6	0.0	583.4	
Stratum 3: 06/14-06/20											
Sampling Dates: 06/14, 06/16, 06/18											
Female:	Number in Sample:	12	0	0	0	0	0	4	1	2	19
	Estimated % of Escapement:	32.4	0.0	0.0	0.0	0.0	0.0	10.8	2.7	5.4	51.4
	Estimated Escapement:	3,618	0	0	0	0	0	1,206	302	603	5,729
	Standard Error:	869.0	0.0	0.0	0.0	0.0	0.0	576.4	301.0	419.8	
Male:	Number in Sample:	11	1	0	0	0	1	3	0	2	18
	Estimated % of Escapement:	29.7	2.7	0.0	0.0	0.0	2.7	8.1	0.0	5.4	48.6
	Estimated Escapement:	3,317	302	0	0	0	302	905	0	603	5,428
	Standard Error:	848.5	301.0	0.0	0.0	0.0	301.0	506.7	0.0	419.8	
Total:	Number in Sample:	23	1	0	0	0	1	7	1	4	37
	Estimated % of Escapement:	62.2	2.7	0.0	0.0	0.0	2.7	18.9	2.7	10.8	100.0
	Estimated Escapement:	6,935	302	0	0	0	302	2,111	302	1,206	11,157
	Standard Error:	900.3	301.0	0.0	0.0	0.0	301.0	727.1	301.0	576.4	

-continued-

		Brood Year and Age Group									
		1998		1997		1996			1995		
		1.2	2.1	1.3	2.2	1.4	2.3	3.2	3.3	4.2	Total
Stratum 4: 06/21-06-27											
Sampling Dates: 06/21, 06/22, 06/24 & 06/26											
Female:	Number in Sample:	14	0	0	1	0	0	9	0	3	27
	Estimated % of Escapement:	37.8	0.0	0.0	2.7	0.0	0.0	24.3	0.0	8.1	73.0
	Estimated Escapement:	780	0	0	56	0	0	501	0	167	1,504
	Standard Error:	165.1	0.0	0.0	55.2	0.0	0.0	146.0	0.0	92.9	
Male:	Number in Sample:	5	1	0	1	0	0	2	0	1	10
	Estimated % of Escapement:	13.5	2.7	0.0	2.7	0.0	0.0	5.4	0.0	2.7	27.0
	Estimated Escapement:	279	56	0	56	0	0	111	0	56	557
	Standard Error:	116.4	55.2	0.0	55.2	0.0	0.0	77.0	0.0	55.2	
Total:	Number in Sample:	19	1	0	2	0	0	11	0	4	37
	Estimated % of Escapement:	51.4	2.7	0.0	5.4	0.0	0.0	29.7	0.0	10.8	100.0
	Estimated Escapement:	1,058	56	0	111	0	0	613	0	223	2,061
	Standard Error:	170.1	55.2	0.0	77.0	0.0	0.0	155.6	0.0	105.7	
Stratum 5: 06/28-07/04											
Sampling Dates: 06/29, 06/30 & 07/03											
Female:	Number in Sample:	14	0	0	0	0	0	3	0	2	19
	Estimated % of Escapement:	45.2	0.0	0.0	0.0	0.0	0.0	9.7	0.0	6.5	61.3
	Estimated Escapement:	769	0	0	0	0	0	165	0	110	1,043
	Standard Error:	153.2	0.0	0.0	0.0	0.0	0.0	91.0	0.0	75.6	
Male:	Number in Sample:	8	2	0	0	0	0	2	0	0	12
	Estimated % of Escapement:	25.8	6.5	0.0	0.0	0.0	0.0	6.5	0.0	0.0	38.7
	Estimated Escapement:	439	110	0	0	0	0	110	0	0	659
	Standard Error:	134.7	75.6	0.0	0.0	0.0	0.0	75.6	0.0	0.0	
Total:	Number in Sample:	22	2	0	0	0	0	5	0	2	31
	Estimated % of Escapement:	71.0	6.5	0.0	0.0	0.0	0.0	16.1	0.0	6.5	100.0
	Estimated Escapement:	1,208	110	0	0	0	0	275	0	110	1,702
	Standard Error:	139.8	75.6	0.0	0.0	0.0	0.0	113.2	0.0	75.6	
Stratum 6: 07/05-07/11											
Sampling Dates: 07/06,07/07, 07/09, 07/10, & 07/11											
Female:	Number in Sample:	15	1	0	0	0	0	4	0	0	20
	Estimated % of Escapement:	44.1	2.9	0.0	0.0	0.0	0.0	11.8	0.0	0.0	58.8
	Estimated Escapement:	115	8	0	0	0	0	31	0	0	153
	Standard Error:	21.0	7.1	0.0	0.0	0.0	0.0	13.6	0.0	0.0	
Male:	Number in Sample:	9	5	0	0	0	0	0	0	0	14
	Estimated % of Escapement:	26.5	14.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.2
	Estimated Escapement:	69	38	0	0	0	0	0	0	0	107
	Standard Error:	18.6	14.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total:	Number in Sample:	24	6	0	0	0	0	4	0	0	34
	Estimated % of Escapement:	70.6	17.6	0.0	0.0	0.0	0.0	11.8	0.0	0.0	100.0
	Estimated Escapement:	184	46	0	0	0	0	31	0	0	260
	Standard Error:	19.2	16.1	0.0	0.0	0.0	0.0	13.6	0.0	0.0	

-continued-

APPENDIX 6.—(Page 3 of 3)

		Brood Year and Age Group									
		1998		1997		1996			1995		
		1.2	2.1	1.3	2.2	1.4	2.3	3.2	3.3	4.2	Total
Stratum 7: 07/12-07/18											
Sampling Dates: 07/12, 07/13, & 07/14											
Female:	Number in Sample:	8	0	0	0	0	0	0	0	0	8
	Estimated % of Escapement:	47.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.1
	Estimated Escapement:	52	0	0	0	0	0	0	0	0	52
	Standard Error:	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Male:	Number in Sample:	6	3	0	0	0	0	0	0	0	9
	Estimated % of Escapement:	35.3	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.9
	Estimated Escapement:	39	19	0	0	0	0	0	0	0	58
	Standard Error:	12.1	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total:	Number in Sample:	14	3	0	0	0	0	0	0	0	17
	Estimated % of Escapement:	82.4	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	Estimated Escapement:	91	19	0	0	0	0	0	0	0	110
	Standard Error:	9.6	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Strata 1 - 7: 5/31-7/18											
Female:	Number in Sample:	76	1	0	1	0	1	38	1	9	127
	% Females in Age Group:	52.8	0.0	0.0	0.3	0.0	0.9	35.7	1.7	8.5	100.0
	Estimated % of Escapement:	27.2	0.0	0.0	0.2	0.0	0.5	18.4	0.9	4.4	51.5
	Estimated Escapement:	9,268	8	0	56	0	166	6,260	302	1,485	17,544
	Standard Error:	1,292.2	7.1	0.0	55.2	0.0	165.8	1,121.1	301.0	607.5	
	Estimated Design Effects:	1.685	0.052	0.000	0.378	0.000	1.133	1.675	2.063	1.769	1.701
Male:	Number in Sample:	50	12	1	1	1	2	31	0	7	105
	% Males in Age Group:	41.9	3.2	1.0	0.3	1.0	3.7	39.2	0.0	9.7	100.0
	Estimated % of Escapement:	20.3	1.5	0.5	0.2	0.5	1.8	19.0	0.0	4.7	48.5
	Estimated Escapement:	6,926	525	166	56	166	604	6,480	0	1,597	16,520
	Standard Error:	1,184.5	315.8	165.8	55.2	165.8	426.5	1,101.2	0.0	641.0	
	Estimated Design Effects:	1.731	1.316	1.133	0.378	1.133	2.086	1.573	0.000	1.838	1.701
Total:	Number in Sample:	126	13	1	2	1	3	69	1	16	232
	Estimated % of Escapement:	47.5	1.6	0.5	0.3	0.5	2.3	37.4	0.9	9.0	100.0
	Estimated Escapement:	16,194	532	166	111	166	770	12,740	302	3,082	34,064
	Standard Error:	1,412.8	315.8	165.8	77.0	165.8	457.6	1,335.9	301.0	861.8	
	Estimated Design Effects:	1.599	1.298	1.133	0.368	1.133	1.893	1.524	2.063	1.803	

APPENDIX 7.—Estimated age and sex composition of sockeye salmon passing the Little River weir, Kodiak Island, Alaska, 2003.

		Brood Year and Age Group								
		2000	1999	1998		1997		1996	1995	
		0.2	1.2	1.3	2.2	2.3	3.2	3.3	4.3	Total
Stratum 1: 5/24 - 5/30										
Sampling Dates: 5/29										
Female:	Number in Sample:	0	0	2	16	0	0	3	1	22
	Estimated % of Escapement:	0.0	0.0	5.4	43.2	0.0	0.0	8.1	2.7	59.5
	Estimated Escapement:	0	0	230	1,837	0	0	344	115	2,525
	Standard Error:	0.0	0.0	159.4	349.1	0.0	0.0	192.4	114.3	
Male:	Number in Sample:	0	0	1	10	0	0	4	0	15
	Estimated % of Escapement:	0.0	0.0	2.7	27.0	0.0	0.0	10.8	0.0	40.5
	Estimated Escapement:	0	0	115	1,148	0	0	459	0	1,722
	Standard Error:	0.0	0.0	114.3	313.0	0.0	0.0	218.8	0.0	
Total:	Number in Sample:	0	0	3	26	0	0	7	1	37
	Estimated % of Escapement:	0.0	0.0	8.1	70.3	0.0	0.0	18.9	2.7	100.0
	Estimated Escapement:	0	0	344	2,984	0	0	803	115	4,247
	Standard Error:	0.0	0.0	192.4	322.1	0.0	0.0	276.0	114.3	
Stratum 2: 5/31 - 06/06										
Sampling Dates: 06/02,06/03,06/05										
Female:	Number in Sample:	0	1	16	76	1	0	11	4	109
	Estimated % of Escapement:	0.0	0.5	7.6	36.0	0.5	0.0	5.2	1.9	51.7
	Estimated Escapement:	0	141	2,254	10,708	141	0	1,550	564	15,357
	Standard Error:	0.0	140.4	541.1	981.3	140.4	0.0	454.4	278.8	
Male:	Number in Sample:	0	1	15	71	1	2	10	2	102
	Estimated % of Escapement:	0.0	0.5	7.1	33.6	0.5	0.9	4.7	0.9	48.3
	Estimated Escapement:	0	141	2,113	10,003	141	282	1,409	282	14,371
	Standard Error:	0.0	140.4	525.3	965.9	140.4	198.1	434.3	198.1	
Total:	Number in Sample:	0	2	31	147	2	2	21	6	211
	Estimated % of Escapement:	0.0	0.9	14.7	69.7	0.9	0.9	10.0	2.8	100.0
	Estimated Escapement:	0	282	4,368	20,711	282	282	2,959	845	29,728
	Standard Error:	0.0	198.1	723.7	939.7	198.1	198.1	611.9	339.8	
Stratum 3: 06/07 - 06/13										
Sampling Dates: 06/09, 06/10, & 06/12										
Female:	Number in Sample:	0	0	14	92	1	0	8	2	117
	Estimated % of Escapement:	0.0	0.0	6.9	45.3	0.5	0.0	3.9	1.0	57.6
	Estimated Escapement:	0	0	1,975	12,977	141	0	1,128	282	16,504
	Standard Error:	0.0	0.0	508.7	999.4	140.6	0.0	390.6	198.3	
Male:	Number in Sample:	0	0	10	65	1	0	7	3	86
	Estimated % of Escapement:	0.0	0.0	4.9	32.0	0.5	0.0	3.4	1.5	42.4
	Estimated Escapement:	0	0	1,411	9,169	141	0	987	423	12,131
	Standard Error:	0.0	0.0	434.5	936.6	140.6	0.0	366.3	242.2	
Total:	Number in Sample:	0	0	24	157	2	0	15	5	203
	Estimated % of Escapement:	0.0	0.0	11.8	77.3	1.0	0.0	7.4	2.5	100.0
	Estimated Escapement:	0	0	3,385	22,146	282	0	2,116	705	28,635
	Standard Error:	0.0	0.0	648.2	840.4	198.3	0.0	525.2	311.2	

-continued-

		Brood Year and Age Group								
		2000	1999	1998		1997		1996	1995	
		0.2	1.2	1.3	2.2	2.3	3.2	3.3	4.3	Total
Stratum 4: 06/14 - 06/20										
Sampling Dates: 06/16, 06/17, & 06/18										
Female:	Number in Sample:	0	0	7	124	0	1	0	1	133
	Estimated % of Escapement:	0.0	0.0	3.2	57.1	0.0	0.5	0.0	0.5	61.3
	Estimated Escapement:	0	0	263	4,653	0	38	0	38	4,990
	Standard Error:	0.0	0.0	96.6	270.5	0.0	37.0	0.0	37.0	
Male:	Number in Sample:	1	1	4	73	0	0	5	0	84
	Estimated % of Escapement:	0.5	0.5	1.8	33.6	0.0	0.0	2.3	0.0	38.7
	Estimated Escapement:	38	38	150	2,739	0	0	188	0	3,152
	Standard Error:	37.0	37.0	73.5	258.2	0.0	0.0	82.0	0.0	
Total:	Number in Sample:	1	1	11	197	0	1	5	1	217
	Estimated % of Escapement:	0.5	0.5	5.1	90.8	0.0	0.5	2.3	0.5	100.0
	Estimated Escapement:	38	38	413	7,392	0	38	188	38	8,142
	Standard Error:	37.0	37.0	119.9	158.1	0.0	37.0	82.0	37.0	
Stratum 5: 06/21 - 06/27										
Sampling Dates: 06/23, 06/24 & 06/25										
Female:	Number in Sample:	0	0	8	110	0	2	2	1	123
	Estimated % of Escapement:	0.0	0.0	3.7	50.2	0.0	0.9	0.9	0.5	56.2
	Estimated Escapement:	0	0	103	1,413	0	26	26	13	1,580
	Standard Error:	0.0	0.0	34.3	91.5	0.0	17.4	17.4	12.3	
Male:	Number in Sample:	0	0	5	85	0	0	3	3	96
	Estimated % of Escapement:	0.0	0.0	2.3	38.8	0.0	0.0	1.4	1.4	43.8
	Estimated Escapement:	0	0	64	1,092	0	0	39	39	1,234
	Standard Error:	0.0	0.0	27.3	89.2	0.0	0.0	21.3	21.3	
Total:	Number in Sample:	0	0	13	195	0	2	5	4	219
	Estimated % of Escapement:	0.0	0.0	5.9	89.0	0.0	0.9	2.3	1.8	100.0
	Estimated Escapement:	0	0	167	2,506	0	26	64	51	2,814
	Standard Error:	0.0	0.0	43.2	57.2	0.0	17.4	27.3	24.5	
Stratum 6: 06/28 - 07/11[a]										
Sampling Dates: 07/02, & 07/03										
Female:	Number in Sample:	0	0	0	24	0	0	0	0	24
	Estimated % of Escapement:	0.0	0.0	0.0	49.0	0.0	0.0	0.0	0.0	49.0
	Estimated Escapement:	0	0	0	142	0	0	0	0	142
	Standard Error:	0.0	0.0	0.0	19.1	0.0	0.0	0.0	0.0	
Male:	Number in Sample:	0	0	0	25	0	0	0	0	25
	Estimated % of Escapement:	0.0	0.0	0.0	51.0	0.0	0.0	0.0	0.0	51.0
	Estimated Escapement:	0	0	0	148	0	0	0	0	148
	Standard Error:	0.0	0.0	0.0	19.1	0.0	0.0	0.0	0.0	
Total:	Number in Sample:	0	0	0	49	0	0	0	0	49
	Estimated % of Escapement:	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	0	0	290	0	0	0	0	290
	Standard Error:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

-continued-

APPENDIX 7.—(Page 3 of 3)

		Brood Year and Age Group								
		2000	1999	1998		1997		1996	1995	
		0.2	1.2	1.3	2.2	2.3	3.2	3.3	4.3	Total
Strata 1 - 6: 5/29-07/11										
Sampling Dates:										
Female:	Number in Sample:	0	1	47	442	2	3	24	9	528
	% Females in Age Group:	0.0	0.3	11.7	77.2	0.7	0.2	7.4	2.5	100.0
	Estimated % of Escapement:	0.0	0.2	6.5	43.0	0.4	0.1	4.1	1.4	55.6
	Estimated Escapement:	0	141	4,824	31,730	282	63	3,048	1,011	41,099
	Standard Error:	0.0	140.4	766.5	1,471.6	198.7	40.9	629.6	362.8	
	Estimated Design Effects:	0.000	1.787	1.662	1.527	1.792	0.348	1.730	1.684	1.559
Male:	Number in Sample:	1	2	35	329	2	2	29	8	408
	% Males in Age Group:	0.1	0.5	11.8	74.2	0.9	0.9	9.4	2.3	100.0
	Estimated % of Escapement:	0.1	0.2	5.2	32.9	0.4	0.4	4.2	1.0	44.4
	Estimated Escapement:	38	178	3,853	24,299	282	282	3,082	744	32,757
	Standard Error:	37.0	145.2	695.6	1,408.3	198.7	198.1	614.7	313.6	
	Estimated Design Effects:	0.475	1.512	1.690	1.553	1.792	1.782	1.633	1.705	1.559
Total:	Number in Sample:	1	3	82	771	4	5	53	17	936
	Estimated % of Escapement:	0.1	0.4	11.7	75.9	0.8	0.5	8.3	2.4	100.0
	Estimated Escapement:	38	319	8,677	56,029	564	345	6,130	1,754	73,856
	Standard Error:	37.0	201.5	998.6	1,312.0	280.3	202.2	856.7	476.8	
	Estimated Design Effects:	0.475	1.629	1.661	1.624	1.790	1.521	1.665	1.693	

[a] Strata 6 includes escapement between 07/05 and 07/11 (*N*=87)

APPENDIX 8.— Daily and cumulative counts and difference between Little River video and weir counts of sockeye salmon between June 4 and July 3, 2002, Kodiak Island, Alaska.

	Daily Counts		Cumulative Counts		Difference
	Weir	Video	Weir	Video	between
Date	2002	2002	2002	2002	Video and Weir
6/4	410	516	410	516	106
6/5	376	517	786	1033	247
6/6	1470	937	2256	1970	-286
6/7	2128	1116	4384	3086	-1298
6/8	2773	1498	7157	4584	-2573
6/9	1387	834	8544	5418	-3126
6/10	2200	2289	10744	7707	-3037
6/11	2208	1290	12952	8997	-3955
6/12	1684	2693	14636	11690	-2946
6/13	1240	2006	15876	13696	-2180
6/14	2366	3691	18242	17387	-855
6/15	1880	2111	20122	19498	-624
6/16	2104	3014	22226	22512	286
6/17	1736	2663	23962	25175	1213
6/18	1467	2672	25429	27847	2418
6/19	1144	2279	26573	30126	3553
6/20	460	747	27033	30873	3840
6/21	191	996	27224	31869	4645
6/22	281	1011	27505	32880	5375
6/23	128	338	27633	33218	5585
6/24	54	479	27687	33697	6010
6/25	1001	766	28688	34463	5775
6/26	89	107	28777	34570	5793
6/27	317	412	29094	34982	5888
6/28	158	199	29252	35181	5929
6/29	93	107	29345	35288	5943
6/30	228	212	29573	35500	5927
7/1	145	133	29718	35633	5915
7/2	731	643	30449	36276	5827
7/3	259	192	30708	36468	5760