Abundance and Run Timing of Adult Pacific Salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2006

Alaska Fisheries Data Series Number 2007-9

Kenai Fish and Wildlife Field Office
Kenai, Alaska
August 2007

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Abstract

The U.S Fish and Wildlife Service, assisted by the Organized Village of Kwethluk, operated a resistance board weir on the Kwethluk River, a tributary to the lower Kuskokwim River between July 4 and September 6, 2006. Data collected were used for in-season management of the commercial and subsistence fisheries in the Kuskokwim drainage. Counts of 42,387 chum *Oncorhynchus keta*, 14,124 Chinook *O. tshawytscha*, 4,066 sockeye *O. nerka*, 1,685 pink *O. gorbuscha*, and 20,239 coho *O. kisutch* salmon were documented through the weir. For periods with incomplete counts due to high water events, fish passage estimates of an additional 5,103 chum, 3,494 Chinook, 2,666 sockeye, and 5,415 coho salmon were calculated. Peak weekly passage occurred July 9 to15 for chum, July 2 to 8 for Chinook and sockeye, July 16 to 22 for pink, and August 13 to19 for coho salmon. Age, sex, and length data were collected for each species except pink salmon. Dominant age classes were: 0.3 for female and 0.4 for male chum, 1.4 for female and 1.2 for male Chinook, 1.3 for sockeye and 2.1 for coho male and female salmon. Over all percentages for female salmon were; chum 41%, Chinook 40%, sockeye 43%, and coho 37%.

Introduction

The Kwethluk River, a lower Kuskokwim River tributary located on the Yukon Delta National Wildlife Refuge (Refuge), provides important spawning and rearing habitat for chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, sockeye *O. nerka*, pink *O. gorbuscha*, and coho *O. kisutch* salmon (Figure 1) (Alt 1977; U.S. Fish and Wildlife Service (Service) 1992). Adult salmon returning to the Kwethluk River migrate 130 river kilometers (rkms) through the lower Kuskokwim River and up to an additional 160 rkms in the Kwethluk River before reaching spawning grounds. In the lower Kuskokwim River, salmon pass through one of Alaska's most intensive subsistence fisheries (Burkey et al. 2001; Service 1988). In general, half of the total Chinook salmon statewide subsistence harvest occurs in the Kuskokwim drainage (Alaska Department Fish and Game (Department), 2001, 2002, 2003a, 2003b).

The Alaska National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats be conserved in their natural diversity within federal lands; that international treaty obligations are fulfilled, and subsistence opportunities for local residents be maintained. Salmon escapement studies for the Kuskokwim River tributaries on the Refuge are priorities in the Refuge Fishery Management Plan (Service 1992). However, management of these mixed species systems of multiple individual stocks is not straight forward. Escapement and run timing, as well as other data are required for sound management strategies (Roettiger et al. 2002, 2004, 2005; Zabkar et al. 2003).

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Under guidelines established in the sustainable salmon fisheries policy 5AAC.39.222, the Alaska Board of Fisheries designated Kuskokwim River chum and Chinook salmon stocks as yield concerns in 2001 based upon the inability, despite specific management measures, to maintain expected yields or have stable surpluses above the stocks' escapement needs for three of the past five years. Management of the Kuskokwim River drainage salmon fishery in 2006 was under the Kuskokwim River Salmon Rebuilding Management Plan (Rebuilding Plan) (Ward et al. 2003; Bergstrom and Whitmore 2004). The portion of the Kuskokwim River within the boundaries of the Refuge was under both the Rebuilding Plan and the Federal Subsistence Fishery Management Program.

The Department, the Service, and the Kuskokwim River Salmon Management Working Group (Working Group) work together to achieve the goals of both the Rebuilding Plan and the Federal Subsistence Fishery Management Program (FRMP). The Plan and Program are to provide management guidelines that result in the sustained yield of salmon stocks large enough to meet the following goals; (1) To manage for the achievement of established escapement goals, (2) To meet the amounts necessary for subsistence, and (3) To allow for a commercial fishery on harvestable surplus after escapement and subsistence needs are projected to be met (Ward et al. 2003). In addition to the goals set by the Department, the Service, and the Working Group, ANILCA mandates that salmon populations and their habitats be conserved in their natural diversity within the Refuge.

In accordance with ANILCA mandates, various enumeration studies have occurred on the Kwethluk River with varying results. The Service and other agencies have funded projects from 1991 to present. The projects' objectives remain consistent: (1) enumerate adult salmon; (2) describe the run timing for chum, Chinook, sockeye, pink, and coho salmon returns; (3) estimate the age, sex, and length composition of adult chum, Chinook, sockeye, and coho salmon populations; and (4) identify and count other fish species passing through the weir.

This weir project remains a high priority for Office Subsistence Management (OSM) - Fisheries Information Service (FIS), the Department, and the Refuge, and continues to be supported, regardless of difficulties associated with the project. High water prevented the installation and operation of the weir in 1991 and 2005, and a late installation in 2001. Opposition to the weir by the Organized Village of Kwethluk (OVK) curtailed operations from 1993 to 1995 but since that time OVK has been a key contributor to its success. Association of Village Council Presidents and OVK operated a tower from 1996 to 1999. Water turbidity and high water plagued counts for different species. Additionally, sampling for age, sex, and length information was unsuccessful in 1996 and 1997, and sampling was discontinued in successive years (Cappiello and Sundown 1998; Cappiello and Chris 1999). The U.S. Fish and Wildlife Service Kenai Fish and Wildlife Field Office (KFWFO) and the OVK have cooperatively conducted weir project operations during six of the past seven years (2000-2006). Weir components were rebuilt in 2005 (Tobin 1994; Harper et al. 2007).

Beginning in 2000 the Kwethluk River weir has played an important role as a platform to collect additional information for other research projects. These include collections of genetic samples for Fisheries Resource Management Program (FRMP) projects (OSM 02-097 and 04-311; Olsen et al. 2006). The weir also plays an important role in monitoring for sockeye, chum, and coho salmon tagged in Kuskokwim River mark-recapture projects for development of total in-river abundance estimates (Kerkvliet et al. 2004). Beginning in 2004, the Salmonid Rivers Observatory Network (SaRON), started a 10 year project focusing on pristine salmon producing rivers in the Bering Sea drainage measuring processes and changes to the shifting habitat mosaic of ecosystems (http://www.umt.edu/flbs/Research/SaRON.htm). The Arctic Yukon Kuskokwim Sustainable Salmon Initiative program (AYK-SSI) initiated a juvenile emigration study in 2006 (http://www.aykssi.org/Research/index.htm). Escapement data collected from the Kwethluk River weir is an integral component to these research projects.

Study Area

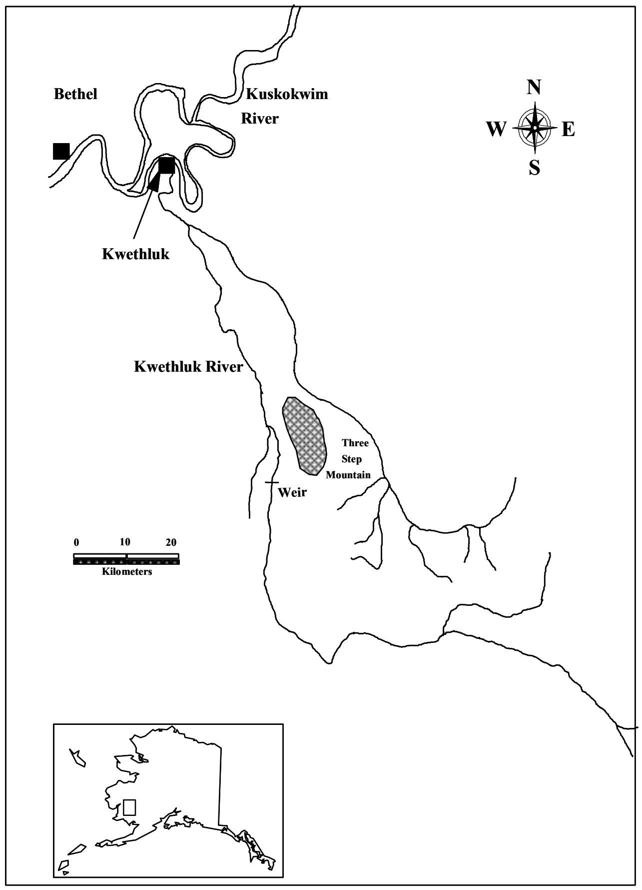

FIGURE 1.─Location of the Kwethluk River weir, 2006.

The Kwethluk River is in the lower Kuskokwim River drainage (Figure 1). The region has a sub-arctic climate characterized by extremes in temperature. Temperatures range from summer highs near 15˚C to average winter lows near -12˚C (Alt 1977). Average yearly precipitation is approximately 50 cm with the majority falling between June and October. The rivers in this area generally become ice-free in the slow moving sections by early-May and freeze up in late-November. Kwethluk River break up can occur in early-April or as late as May. The Kwethluk River originates in the Kilbuck Mountains, flows northwest approximately 222 km, and drains an area of about 3,367 km^2. The weir is located in the middle section of the river characterized by braiding and gravel substrates. Below the middle section, the lower 47 km consists of a deeper, muddy-bottomed channel averaging 53 m in width (Alt 1977). Turbid water conditions, the result of active stream cutting on tundra banks, are also characteristic of the lower section and incompatible with weir operations.

Methods

Weir Operations

A resistance board weir (Tobin 1994; Stewart 2002) spanning 56 m was installed in the Kwethluk River N 60° 29’44.68”, W 161° 05’54.79” (NAD 83) approximately 88 rkm upstream from the Kuskokwim River and 43 air-km east of Kwethluk, Alaska (Figure 1). This location is approximately 2.4 rkm downstream from the 1992 weir site described by Harper (1998). The weir was re-located in 2000 due to channel morphology changes. A staff gauge was installed upstream of the weir to measure daily water levels and measurements were correlated to correspond with the average water depth across the river channel at the upstream edge of the weir. Water temperatures were collected daily at the site June 25 through September 10 using a Hobo© temperature recorder.

One live trap and a counting passageway were installed to facilitate sampling and fish passage during varying river water stage heights. All fish were enumerated to species as they migrated through the live trap or passage chute (Harper 1998). Fish passed through the trap and counts were taken intermittently between 0001 hours and midnight of each day. The duration of counting sessions varied depending on the intensity of fish passage and recorded to the nearest 0.25 hour at each counting station.

The weir was inspected for holes and cleaned daily. An observer outfitted with snorkeling gear checked weir integrity and substrate conditions. Cleaning consisted of raking debris from the upstream surface of the weir or walking across each panel until partially submerged, allowing the current to wash accumulated debris downstream.

Biological Data

Sample week, or strata, began on Sunday and ended the following Saturday. However, a partial week of weir operation shortened the first and last strata. Sampling generally commenced near the beginning of the week and an effort was made to obtain a weekly quota of 200 chum, 210 Chinook, and 200 sockeye salmon in as short a period (1-3 days) as possible, to approximate a pulse or snapshot sample (Geiger et al. 1990). The sample objective for coho salmon was 210 for the season with samples from the early, middle, and late part of the run. All target species trapped were sampled to prevent bias.

Fish sampling consisted of measuring length, determining sex, collecting scales, and then releasing the fish upstream of the weir. Length was measured from mid-eye to the fork of the caudal fin and rounded to the nearest 5mm. Sex was determined by observing external characteristics, including presence of ovipositor or gametes. Scales were removed from the preferred area for age determination following Koo (1962) and Mosher (1968). One scale was collected from each chum and sockeye salmon, and four from each Chinook and coho salmon. Scale impressions were made on cellulose acetate cards, using a heated scale press, and examined with a microfiche reader. A Department biologist determined age and reported results according to the European Method (Koo 1962).

Characteristics of fish passing through the weir were estimated using standard stratified random sampling estimators (Cochran 1977). Within a given stratum *m*, the proportion of species *i* passing the weir that are of sex *j* and age *k* (p_{ijkm}) was estimated as

$$\hat{p}_{ijkm} = \frac{n_{ijkm}}{n_{i++m}}$$

where n_{ijkm} denotes the number of fish of species *i*, sex *j*, and age *k* sampled during stratum *m* and a subscript of "+" represents summation over all possible values of the corresponding variable, e.g., n_{i++m} denotes the total number of fish of species *i* sampled in stratum *m*. The variance of $\hat{p}_{ijkm}$ was estimated as

$$\hat{v}\left(\hat{p}_{ijkm}\right) = \left(1 - \frac{n_{i++m}}{N_{i++m}}\right) \frac{\hat{p}_{ijkm}\left(1 - \hat{p}_{ijkm}\right)}{n_{i++m} - 1}$$

where N_{i++m} denotes the total number of species *i* fish passing the weir in stratum *m*. The estimated number of fish of species *i*, sex *j*, age *k* passing the weir in stratum *m* (N_{ijkm}) is

$$\hat{N}_{ijkm} = N_{i++m}\,\hat{p}_{ijkm}$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijkm}\right) = N_{i++m}^2\,\hat{v}\left(\hat{p}_{ijkm}\right)$$

Estimates of proportions for the entire period of weir operation were computed as weighted sums of the stratum estimates, i.e.,

$$\hat{p}_{ijk} = \sum_m \left(\frac{N_{i++m}}{N_{i+++}}\right) \hat{p}_{ijkm}$$

with estimated variance

$$\hat{v}\left(\hat{p}_{ijk}\right) = \sum_m \left(\frac{N_{i++m}}{N_{i+++}}\right)^2 \hat{v}\left(\hat{p}_{ijkm}\right)$$

The total number of fish in a species, sex, and age category passing the weir during the entire period of operation was estimated as

$$\hat{N}_{ijk} = \sum_m \hat{N}_{ijkm}$$

with estimated variance.

$$\hat{v}\left(\hat{N}_{ijk}\right) = \sum_m \hat{v}\left(\hat{N}_{ijkm}\right)$$

If the length of the r^{th} fish of species *i*, sex *j*, and age *k* sampled in stratum *m* is denoted x_{ijkmr}, the mean length of all such fish (μ_{ijkm}) was estimated as

$$\hat{\mu}_{ijkm} = \left(\frac{1}{n_{ijkm}}\right)\sum_{r} x_{ijkmr}$$

with corresponding variance estimator.

$$\hat{v}(\hat{\mu}_{ijkm}) = \left(1 - \frac{n_{ijkm}}{\hat{N}_{ijkm}}\right)\frac{\sum_{r}(x_{ijkmr} - \hat{\mu}_{ijkm})^2}{n_{ijkm}(n_{ijkm} - 1)}$$

The mean length of all fish of species *i*, sex *j*, and age *k* (μ_{ijk}) was estimated as a weighted sum of the stratum means, i.e.,

$$\hat{\mu}_{ijk} = \sum_{m}\left(\frac{\hat{N}_{ijkm}}{\hat{N}_{ijk}}\right)\hat{\mu}_{ijkm}$$

An approximate estimator of the variance of $\hat{\mu}_{ijk}$ was obtained using the delta method (Seber 1982).

$$\hat{v}(\hat{\mu}_{ijk}) = \sum_{m}\left\{\hat{v}(\hat{N}_{ijkm})\left[\frac{\hat{\mu}_{ijkm}}{\sum_{x}\hat{N}_{ijkx}} - \sum_{y}\frac{\hat{N}_{ijky}\,\hat{\mu}_{ijky}}{\left(\sum_{x}\hat{N}_{ijkx}\right)^2}\right]^2 + \left(\frac{\hat{N}_{ijkm}}{\sum_{x}\hat{N}_{ijkx}}\right)^2\hat{v}(\hat{\mu}_{ijkm})\right\}$$

A two-sample *t-test* for samples of unequal variance (Microsoft Office Excel 2003) was used to test the hypothesis that male and female fish of age *k* have equal mean lengths ($\alpha = 0.05$). Data were pooled across all strata and treated as one sample to compare lengths.

Estimates of missed salmon passage

For days when high water prevented accurate counts, estimates were made using percent passage data from previous years with complete data. The passage for the jth day with missing data was estimated as:

$$\hat{n}_j = \left[\frac{\sum_{i=1}^{D}\theta_i n_i}{\sum_{i=1}^{D}\theta_i p_i}\right]p_j,$$

where

n_i = weir passage on day i,

p_i = proportional passage on day i based on historical data,

θ_i = an indicator variable defined as 1 if passage was observed on day i, 0 otherwise, and

D = number of days in the season.

Carcass counts

Technicians counted post-spawn salmon and carcasses of dead salmon that washed up on the weir. Counts were to species and the salmon passed downstream. Carcass counts took place at the beginning of the first shift, at each subsequent crew change, and at the end of the last member's shift. This resulted in counts at least every four hours.

Mark-recapture tag recovery

The Kwethluk River weir was used as a platform for collecting data from the main stem Kuskokwim River mark recapture study. Observers gathered information on recaptured tag numbers, and total tags by color observed, and looked for a secondary mark. Re-captured tagged and total tagged fish were used in generating abundance and run timing estimates. Fish sampled for age, sex, and length were examined for secondary marks used to estimate tag loss (Kerkvliet et al. 2004).

Genetics

Fin clips 1cm^2 in size from a bony fin (i.e. caudal, dorsal, pectoral or pelvic), were taken from live and dead Chinook salmon. The target sample size was a sub-sample of 50 fin clips from the live ASL sampled Chinook salmon. A sample size of 100 males and 100 females was the target sample size for dead or spawned out Chinook salmon that washed up on the weir. Samples were placed in 1.5ml vials with 95% ethanol. Vials were numbered sequentially, labeled male (M) or female (F), and live or dead. If the sample was taken from a dead fish the vial was labeled to indicate carcass quality based on gill color with a numeric value of one to four with 'one being white' and 'four being red'. Data sheets were completed for each collection with appropriate information (i.e. date, location, etc.), and collections were shipped to the Service's Conservation Genetics Laboratory (CGL), Anchorage, Alaska.

Results

Weir

Refuge pilots started monitoring water and ice conditions in early March. Beginning April 19, the crew used snow machines and a helicopter to transport new weir components (Harper et al. 2007) and supplies to the site and completed weir panel installation on April 26. On June 27, the crew returned to the weir site, removed debris and mud from the rail, and set resistance boards. The trap was set July 2, and the weir became operational July 4. Elevated water levels and increased water velocity contributed to a later start than the schedule date of June 24. Between August 14 and August 27, another high water event completely submerged the boat passage panels and crew members observed coho salmon passing over these panels. Counting terminated on September 6, 2006 due to continual rain, rising waters and fear of loosing the newly built weir to flood conditions. Estimates for uncounted salmon were generated for these periods. Water level and temperature data were collected on a daily basis (Appendix 1).

Biological Data

Chum Salmon.—A count of 42,387 chum salmon, passed through the weir between July 4 and September 6, 2006, with an estimated total of 47,490 for the entire run. Peak weekly passage (N = 12,541) occurred during the week of July 9 to July 15 (Figure 2).

Four age groups were identified from scale samples (0.2, 0.3, 0.4 and 0.5). The predominant age group for males was 0.4 (52%) and 0.3 (51%) for females. Age groups 0.3 and 0.4 accounted for 99% of the male and 97% of the female escapements (Appendix 3). Males comprised 59% of the total run, never falling below 52%, except in strata five and six (Figure 3, Appendix 3). Mean length of males was greater than that of females except for the 0.2 age group. Sufficient data for analysis was not available for age group 0.5 (Appendices 4 and 5).

The median-cumulative passage date for escaping chum salmon (Appendix 2) was July 15 and August 3 for chum carcasses, a difference of 19 days. A total of 2,175 chum salmon carcasses were passed downstream over the weir between July 4 and September 6.

Chinook Salmon.—A total of 14,124 Chinook salmon passed through the weir from July 4 to September 6, 2006, with an estimated total of 17,619 for the entire run. Peak-weakly passage (N = 4,769) occurred during the week of July 2 to July 8 (Figure 2). Median-cumulative passage occurred on July 12 (Appendix 2) and August 14 for Chinook salmon carcasses, a difference of 31 days. A total of 185 Chinook salmon carcasses were passed downstream over the weir between July 2 and September 6 with the first recorded on July 13 and the last on September 3.

Seven age groups were identified from scale samples (1.1, 1.2, 1.3, 2.2, 1.4, 1.5 and 2.4). For males, the predominant age group was 1.2 (54%). For females, the predominant age group was 1.4 (82%). In males, age groups 1.2 and 1.3 accounted for 93% of the escapement. In females, age groups 1.3 and 1.4 accounted for 96% of the escapement. Overall, females made up 40% of the escapement (Appendix 6). Males were the majority of the escapement in the first three strata. Escapement for females increased as the run progressed and made up as high as 53% and 52% of the last 2 strata respectively (Figure 3). Mean length of females was greater than that of males for age groups 1.3, 1.4 and 1.5 (Appendices 5 and 7).

One hundred tissue samples were taken from live migrating Chinook salmon, and 120 samples were taken from Chinook salmon carcasses collected on the weir for genetic analysis. Carcass samples were taken to validate use of sex linked markers and qualifying tissue degradation problems associated with some genetics lab protocols. Samples were sent to the CGL, in September 2006.

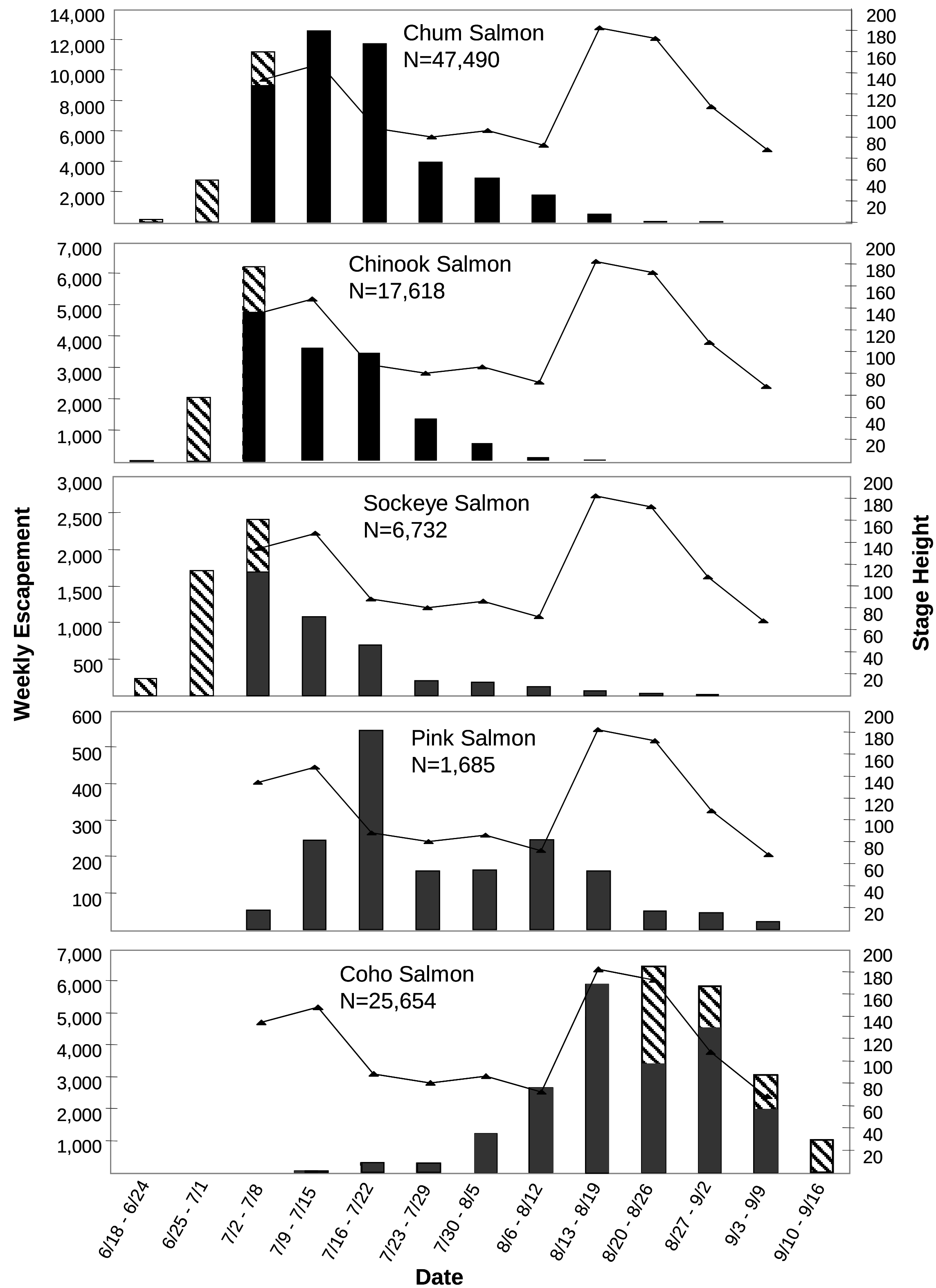

FIGURE 2.—Weekly water stage height, and salmon escapement including estimates (shaded portion of bars) of chum, Chinook, sockeye, pink, and coho salmon, at the Kwethluk River weir, 2006.

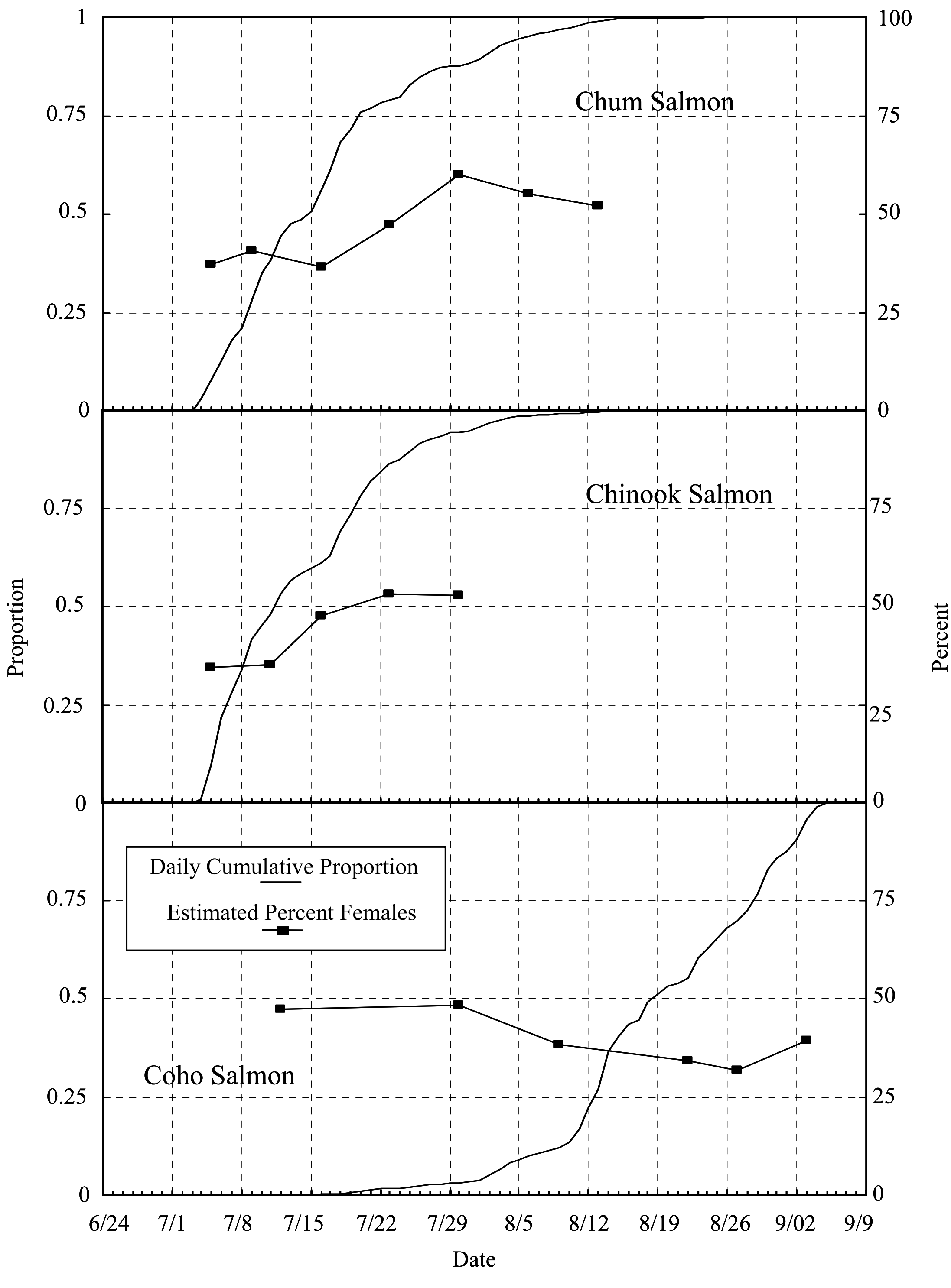

FIGURE 3.—Daily cumulative proportion of escapement, and percentage of females, by week, for chum, Chinook, and coho salmon at the Kwethluk River weir, 2006.

Sockeye Salmon.─A total of 4,066 sockeye salmon passed through the weir from July 4 to September 6, 2006, with an estimated total of 6,732 for the entire run. Peak-weekly passage (N = 1,689) occurred during the week of July 2 to July 8 (Figure 2). Median-cumulative passage occurred on July 10 (Appendix 2).

Four age groups were identified from scales (0.3, 1.2, 1.3 and 1.4). For both males and females age 1.3 was the predominant group making up 74% of the sample. Males made up the majority of the first and last stratum. Females made up 43% of the total escapement and were more prevalent in the middle part of the run (Appendix 8). Mean lengths for males ages 1.2 and 1.3 were larger than for females of the same age groups and age 1.3 was larger in both males and females than age 1.2 (Appendix 9).

Sockeye salmon carcasses were first recorded on July 9. Median-cumulative passage dates for escaping sockeye salmon and for sockeye salmon carcasses washing onto the weir were separated by 44 days. A total of 77 carcasses were passed downstream over the weir between July 4 and September 6.

Pink Salmon.─A total of 1,685 pink salmon passed through the weir from July 4 to September 6, 2006, with no estimate calculated. Peak-weekly passage (N = 545) occurred during the week of July 16 to July 22 (Figure 2). Median-cumulative passage occurred on July 22 (Appendix 2) and August 3 for pink salmon carcasses, a difference of 12 days.

Pink salmon carcasses were first recorded on July 23 and the last on September 6. A total of 749 carcasses were passed downstream over the weir between July 4 and September 6.

Coho Salmon.─A total of 20,239 coho salmon passed through the weir from July 4 to September 6, 2006, with an estimated total of 25,654 for the entire run. Peak-weekly passage (N = 5,896) occurred during the week of August 13 to August 19 (Figure 2). Median-cumulative passage of coho salmon occurred on August 19 (Appendix 2).

Three age groups were identified from scales (1.1, 2.1 and 3.1). Age 2.1 was the predominant group for both males and females, making up 93% and 92% of the sample, respectively. Overall, males made up the majority of each stratum. Females made up 37% of the total escapement and were more prevalent in the early part of the run. (Figure 3, Appendix 10). Mean lengths for ages 1.1 and 2.1 were essentially the same for males and females with males longer at age 3.1 (Appendices 5 and 11).

Coho salmon carcasses were first recorded on August 23. A total of 3 coho salmon carcasses were passed downstream over the weir between July 4 and September 6

Resident Species

In addition to the returning salmon, 35 Dolly Varden *Salvelinus malma*, 43 whitefish Coregoninae, 25 Arctic grayling *Thymallus arcticus*, and 68 rainbow trout *O. mykiss* were counted through the weir.

Mark-Recapture Tag Recovery

Two tagged sockeye and one tagged Chinook salmon migrated through the weir between August 5 and August 12, 2006. Tag information was recorded and forwarded to the Department.

Discussion

Weir Operations

Aerial surveys were conducted beginning in late March through April to determine when the weir site was clear of ice and water levels low enough for installation of the weir. Installing the weir in April avoids the annual high water event which begins in May and often continues until August, depending upon air temperature, snow pack, and rainfall. High water conditions delayed weir operations until July 4 and again were cause for pulling the weir earlier than normal in September 2006. Total escapement estimates were generated for missed statistical weeks or periods and may be biased or imprecise due to the number of fish uncounted. Past events prevented weir operations entirely in 1991 and 2005, and delayed weir installation until August 12 in 2001.

Picket spacing on the weir is such that smaller pink salmon and resident species are able to pass uncounted between pickets while other salmon species are effectively blocked. Thus, counts of pink salmon and resident species are probably below actual passage.

Biological Data

Chum Salmon.―The chum salmon weir count (N = 42,387) was one of the highest on record and well above the 5 year average (Appendix 12) and does not include an additional 5,103 chum salmon estimated to have passed prior to weir operations. Median-cumulative passage was July 15. The proportion of females (41%) was slightly lower than 2003 and 2004 continuing the downward trend seen in past years (Table 1) (Harper 1998; Roettiger et al. 2005).

TABLE 1.―Median-cumulative passage dates and percent female for chum, Chinook, sockeye, pink and coho salmon at the Kwethluk river weir, Alaska, 2006.

	Chum		Chinook		Sockeye		Pink		Coho	
Year	Median Date	% Female	Median Date	% Female	Median Date	% Female	Median Date	% Female	Median Date	% Female
1992	7/18	54	7/9	25	7/18	60	8/13	-	8/26	43
2000	7/16	50	7/13	21	7/1	49	8/4	-	8/21	45
2001	-	-	-	-	-	-	-	-	8/25	51
2002	7/17	47	7/10	22	7/11	60	7/25	-	8/28	45
2003	7/22	44	7/11	19	7/7	55	8/1	-	8/29	51
2004	7/14	43	7/8	17	7/1	48	8/6	-	8/29	43
2006	7/15	41	7/12	40	7/10	43	7/22	-	8/19	37

Chinook Salmon.―The Chinook salmon weir count (N = 14,124) was a decrease from the record escapement of 2004, similar to the 2003 escapement and above the 5 year average (Appendix 12). However this number does not include 3,494 Chinook salmon estimated to have passed at the beginning of the season prior to weir operations. The total passage estimate (N = 17,618) suggests that 19% of the overall escapement of Chinook salmon may have migrated undetected prior to the weir being operational. This estimate would put the median-cumulative passage of Chinook salmon as average which is similar to Chinook salmon passage on the George, Tatlawiksuk, and Kogrukluk rivers (John Linderman, ADFG personal communications).

Median-cumulative passage (July 12) was four days later than the median in 2004. The proportion of females (40%) was the highest on record and almost twice the highest previous record of 25% found in 1992 (Table 1) (Harper 1998; Roettiger et al. 2005).

Sockeye Salmon.—The Kwethluk River is not known for having a large run of sockeye salmon. They are harvested mainly as by-catch but are highly regarded as a food fish. Observed count (N = 4,066) in 2006 was the highest recorded, continuing an upward trend of abundance (Appendix 10). However this figure is regarded as incomplete. An estimated 2,666 (36%) passed prior to the weir being operational essentially doubling the average escapement of previous years (Appendix 12). This estimate is based upon five years of passage data, 1992, 2000, 2002, 2003 and 2004, and appears to be a relatively good approximation of the fish missed. High numbers of sockeye salmon were seen at other enumeration projects on the Kuskowim River including the Tuluksak River weir, (Plumb et al. 2007). The proportion of females (43%) was the lowest recorded (Table 1).

Pink Salmon.—The observed passage of pink salmon (N = 1,685) is a 44% decrease over 2004, which was the largest count since the weir, with wider picket spacing, came into use in 2000 (Appendix 10) (Roettiger et al. 2005). Median-cumulative passage occurred 4 days later than in 2004 and 2 days earlier than 2003, within the range of previous years. Age, sex, and length data were not collected for pink salmon (Table 1) (Harper 1998; Roettiger et al. 2005).

Roettiger et al. (2005) assumed that the wider spacing of the pickets would allow most pink salmon to pass upstream uncounted. The expected ratio of carcasses washed up on the weir to total count should therefore increase because “mortalities” would have approximately the same odds of washing on to the weir while the migrating fish would have a reduced chance of being counted. We have only one year (1992) of weir data with narrow spaced pickets for comparison. Data suggest that the counts of pink salmon may be closer to the actual escapement than previously thought (Roettiger et al. 2005).

Coho Salmon.—The coho salmon count (N = 20,239) was less than previous years. However this figure is regarded as incomplete. High water events submerged boat passage panels August 12 through August 28 and coho were observed passing over the panels. A total passage estimate (N = 25,654) generated from previous years with complete counts for the same time period suggest that 21% of the overall escapement of coho salmon may have migrated undetected during these events. This estimate is still below the 6 year average and substantially below the 2003 and 2004 totals (Appendix 12). The proportion of females (37%) is the lowest recorded at the weir (Appendix 10, Table 1).

Recommendations

The Kwethluk River weir continues to be an important monitoring project concerning salmon stocks originating on the Refuge and for providing information to the Department and Federal In-Season Subsistence Fishery Managers of the Kuskokwim River fisheries. It is recommended that the weir project continue to be operated on a yearly basis. It is further recommended that operations be continued into September to get as complete a count of coho salmon as possible. Early installation, prior to spring runoff, is also recommended though it may be costly in some years with ‘little to no snow’ due to helicopter availability. To fulfill these recommendations, the existing weir will need extensive repairs or replacement on a continual basis.

Acknowledgements

Special appreciation is extended to the crew that staffed the weir: Jason Montoya and Darryl Sipary from KFWFO; Jimmy Andrew, Adam Fisher, John Fisher, and Brian Spein from OVK. Wade Grubs assisted in the installation of the weir and throughout the season other Refuge staff provided support for this project. Special thanks to Frank Harris of the KFWFO for his knowledge of the process, problem solving abilities and extra effort in making things 'work'.

Also greatly appreciated was the assistance of the Alaska Department of Fish and Game, Division of Commercial Fisheries, Arctic Yukon Kuskokwim Region, and Doug Molyneaux. Analysis of Kuskokwim River scale samples is supported by a U.S. Fish and Wildlife Service, Office of Subsistence Management Cooperative Agreement with the Alaska Department of Fish and Game under Project FIS 01-117.

The U.S. Fish and Wildlife Service, Office of Subsistence Management provided funding for this project through the Fisheries Resource Monitoring Program, Project FIS 04-301. As a partner, OVK hired local residents to staff the weir, purchased supplies, and performed equipment maintenance.

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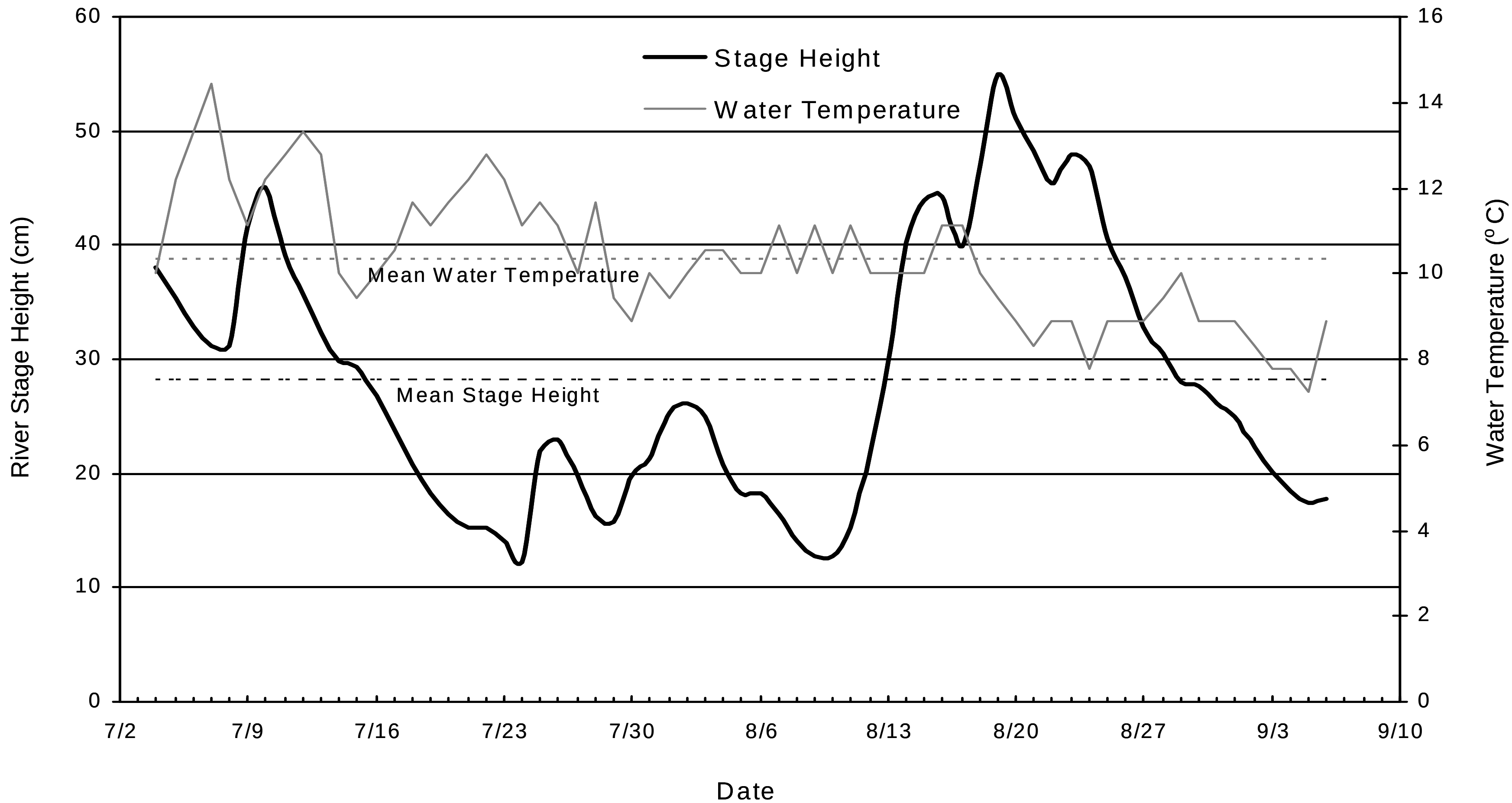

APPENDIX 1.—River stage heights, and water temperatures at the Kwethluk River weir, Alaska, 2006.

APPENDIX 2.—Daily counts, cumulative counts, and cumulative proportions of chum, Chinook, sockeye, pink, and coho salmon escapement through the Kwethluk River weir, Alaska, 2006.

Date	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumalative		Daily	Cumalative		Daily	Cumalative		Daily	Cumalative		Daily	Cumalative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
7/4	1,265	1,265	0.030	160	160	0.011	246	246	0.061	9	9	0.005	0	0	0.000
7/5	2,059	3,324	0.078	1,200	1,360	0.096	511	757	0.186	12	21	0.012	0	0	0.000
7/6	2,075	5,399	0.127	1,708	3,068	0.217	443	1,200	0.295	17	38	0.023	0	0	0.000
7/7	2,143	7,542	0.178	896	3,964	0.281	278	1,478	0.364	3	41	0.024	0	0	0.000
7/8	1,419	8,961	0.211	805	4,769	0.338	211	1,689	0.415	12	53	0.031	0	0	0.000
7/9	2,973	11,934	0.282	1,129	5,898	0.418	295	1,984	0.488	15	68	0.040	1	1	0.000
7/10	3,036	14,970	0.353	494	6,392	0.453	228	2,212	0.544	89	157	0.093	5	6	0.000
7/11	1,265	16,235	0.383	355	6,747	0.478	148	2,360	0.580	35	192	0.114	4	10	0.000
7/12	2,601	18,836	0.444	764	7,511	0.532	149	2,509	0.617	20	212	0.126	1	11	0.001
7/13	1,359	20,195	0.476	482	7,993	0.566	91	2,600	0.639	33	245	0.145	1	12	0.001
7/14	420	20,615	0.486	250	8,243	0.584	70	2,670	0.657	21	266	0.158	9	21	0.001
7/15	887	21,502	0.507	170	8,413	0.596	96	2,766	0.680	31	297	0.176	6	27	0.001
7/16	2,345	23,847	0.563	202	8,615	0.610	109	2,875	0.707	77	374	0.222	8	35	0.002
7/17	2,094	25,941	0.612	275	8,890	0.629	87	2,962	0.728	63	437	0.259	8	43	0.002
7/18	2,956	28,897	0.682	821	9,711	0.688	122	3,084	0.758	95	532	0.316	48	91	0.004
7/19	1,417	30,314	0.715	612	10,323	0.731	94	3,178	0.782	82	614	0.364	63	154	0.008
7/20	1,801	32,115	0.758	707	11,030	0.781	149	3,327	0.818	104	718	0.426	89	243	0.012
7/21	487	32,602	0.769	514	11,544	0.817	64	3,391	0.834	72	790	0.469	23	266	0.013
7/22	579	33,181	0.783	341	11,885	0.841	67	3,458	0.850	52	842	0.500	59	325	0.016
7/23	228	33,409	0.788	302	12,187	0.863	55	3,513	0.864	16	858	0.509	21	346	0.017
7/24	400	33,809	0.798	111	12,298	0.871	21	3,534	0.869	15	873	0.518	12	358	0.018
7/25	1,333	35,142	0.829	309	12,607	0.893	41	3,575	0.879	39	912	0.541	48	406	0.020
7/26	779	35,921	0.847	299	12,906	0.914	23	3,598	0.885	13	925	0.549	50	456	0.023
7/27	656	36,577	0.863	160	13,066	0.925	41	3,639	0.895	39	964	0.572	77	533	0.026
7/28	385	36,962	0.872	84	13,150	0.931	9	3,648	0.897	21	985	0.585	32	565	0.028
7/29	164	37,126	0.876	123	13,273	0.940	11	3,659	0.900	17	1,002	0.595	40	605	0.030
7/30	63	37,189	0.877	25	13,298	0.942	1	3,660	0.900	6	1,008	0.598	18	623	0.031
7/31	194	37,383	0.882	68	13,366	0.946	18	3,678	0.905	22	1,030	0.611	56	679	0.034

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	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
Date	Daily	Cumalative		Daily	Cumalative		Daily	Cumalative		Daily	Cumalative		Daily	Cumalative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
8/1	513	37,896	0.894	116	13,482	0.955	20	3,698	0.909	25	1,055	0.626	117	796	0.039
8/2	614	38,510	0.909	133	13,615	0.964	43	3,741	0.920	24	1,079	0.640	229	1,025	0.051
8/3	747	39,257	0.926	131	13,746	0.973	47	3,788	0.932	28	1,107	0.657	341	1,366	0.067
8/4	451	39,708	0.937	96	13,842	0.980	28	3,816	0.939	39	1,146	0.680	304	1,670	0.083
8/5	292	40,000	0.944	26	13,868	0.982	22	3,838	0.944	19	1,165	0.691	136	1,806	0.089
8/6	305	40,305	0.951	17	13,885	0.983	32	3,870	0.952	16	1,181	0.701	216	2,022	0.100
8/7	378	40,683	0.960	28	13,913	0.985	20	3,890	0.957	24	1,205	0.715	168	2,190	0.108
8/8	140	40,823	0.963	10	13,923	0.986	9	3,899	0.959	9	1,214	0.720	103	2,293	0.113
8/9	243	41,066	0.969	28	13,951	0.988	9	3,908	0.961	21	1,235	0.733	131	2,424	0.120
8/10	229	41,295	0.974	24	13,975	0.989	13	3,921	0.964	45	1,280	0.760	325	2,749	0.136
8/11	227	41,522	0.980	18	13,993	0.991	12	3,933	0.967	56	1,336	0.793	652	3,401	0.168
8/12	257	41,779	0.986	20	14,013	0.992	27	3,960	0.974	74	1,410	0.837	1,051	4,452	0.220
8/13	140	41,919	0.989	15	14,028	0.993	15	3,975	0.978	68	1,478	0.877	1,014	5,466	0.270
8/14	141	42,060	0.992	33	14,061	0.996	17	3,992	0.982	42	1,520	0.902	1,900	7,366	0.364
8/15	101	42,161	0.995	9	14,070	0.996	17	4,009	0.986	15	1,535	0.911	765	8,131	0.402
8/16	61	42,222	0.996	5	14,075	0.997	3	4,012	0.987	12	1,547	0.918	629	8,760	0.433
8/17	23	42,245	0.997	3	14,078	0.997	3	4,015	0.987	3	1,550	0.920	261	9,021	0.446
8/18	33	42,278	0.997	8	14,086	0.997	8	4,023	0.989	14	1,564	0.928	872	9,893	0.489
8/19	2	42,280	0.997	6	14,092	0.998	1	4,024	0.990	5	1,569	0.931	455	10,348	0.511
8/20	18	42,298	0.998	1	14,093	0.998	7	4,031	0.991	8	1,577	0.936	428	10,776	0.532
8/21	10	42,308	0.998	2	14,095	0.998	6	4,037	0.993	10	1,587	0.942	136	10,912	0.539
8/22	8	42,316	0.998	1	14,096	0.998	2	4,039	0.993	5	1,592	0.945	271	11,183	0.553
8/23	6	42,322	0.998	4	14,100	0.998	3	4,042	0.994	10	1,602	0.951	1,016	12,199	0.603
8/24	5	42,327	0.999	0	14,100	0.998	0	4,042	0.994	4	1,606	0.953	400	12,599	0.623
8/25	6	42,333	0.999	3	14,103	0.999	7	4,049	0.996	7	1,613	0.957	583	13,182	0.651
8/26	10	42,343	0.999	8	14,111	0.999	6	4,055	0.997	6	1,619	0.961	560	13,742	0.679
8/27	2	42,345	0.999	0	14,111	0.999	1	4,056	0.998	2	1,621	0.962	343	14,085	0.696
8/28	6	42,351	0.999	0	14,111	0.999	0	4,056	0.998	10	1,631	0.968	585	14,670	0.725
8/29	10	42,361	0.999	4	14,115	0.999	0	4,056	0.998	9	1,640	0.973	835	15,505	0.766
8/30	7	42,368	1.000	1	14,116	0.999	1	4,057	0.998	12	1,652	0.980	1,238	16,743	0.827
8/31	5	42,373	1.000	4	14,120	1.000	3	4,060	0.999	3	1,655	0.982	562	17,305	0.855

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	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
Date	Daily	Cumalative		Daily	Cumalative		Daily	Cumalative		Daily	Cumalative		Daily	Cumalative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
9/1	2	42,375	1.000	1	14,121	1.000	4	4,064	1.000	6	1,661	0.986	393	17,698	0.874
9/2	7	42,382	1.000	2	14,123	1.000	1	4,065	1.000	3	1,664	0.988	573	18,271	0.903
9/3	1	42,383	1.000	0	14,123	1.000	0	4,065	1.000	8	1,672	0.992	1,051	19,322	0.955
9/4	3	42,386	1.000	0	14,123	1.000	0	4,065	1.000	10	1,682	0.998	651	19,973	0.987
9/5	1	42,387	1.000	1	14,124	1.000	1	4,066	1.000	3	1,685	1.000	229	20,202	0.998
9/6	0	42,387	1.000	0	14,124	1.000	0	4,066	1.000	0	1,685	1.000	37	20,239	1.000

APPENDIX 3.–Estimated age and sex composition of weekly chum salmon escapements through the Kwethluk River weir, Alaska, 2006, and estimated design effects of the stratified sampling design.

		Brood Year and Group					
		2003	2002	2001	2000		
		0.2	0.3	0.4	0.5	Total	
Strata 1-3: 06/18 - 07/08							
Sampling Dates: 7/5-7/7							
Female:	Number in Sample:	0	27	47	0	74	
	Estimated % of Escapement:	0.0	13.6	23.7	0.0	37.4	
	Estimated Escapement:	0	1,918	3,338	0	5,256	*
	Standard Error:	0.0	341.4	423.3	0.0		
Male:	Number in Sample:	0	43	81	0	124	
	Estimated % of Escapement:	0.0	21.7	40.9	0.0	62.6	
	Estimated Escapement:	0	3,054	5,753	0	8,808	*
	Standard Error:	0.0	410.2	489.2	0.0		
Total:	Number in Sample:	0	70	128	0	198	
	Estimated % of Escapement:	0.0	35.4	64.6	0.0	100.0	
	Estimated Escapement:	0	4,972	9,092	0	14,064	*
	Standard Error:	0.0	475.6	475.6	0.0		
Stratum 4: 07/09 - 07/15							
Sampling Dates: 7/9-7/12							
Female:	Number in Sample:	0	41	36	0	77	
	Estimated % of Escapement:	0.0	21.7	19.0	0.0	40.7	
	Estimated Escapement:	0	2,721	2,389	0	5,109	
	Standard Error:	0.0	374.1	356.4	0.0		
Male:	Number in Sample:	0	50	62	0	112	
	Estimated % of Escapement:	0.0	26.5	32.8	0.0	59.3	
	Estimated Escapement:	0	3,318	4,114	0	7,432	
	Standard Error:	0.0	400.4	426.2	0.0		
Total:	Number in Sample:	0	91	98	0	189	
	Estimated % of Escapement:	0.0	48.1	51.9	0.0	100.0	
	Estimated Escapement:	0	6,038	6,503	0	12,541	
	Standard Error:	0.0	453.6	453.6	0.0		
Stratum 5: 07/16 - 07/22							
Sampling Dates: 7/16							
Female:	Number in Sample:	2	31	34	0	67	
	Estimated % of Escapement:	1.1	16.9	18.6	0.0	36.6	
	Estimated Escapement:	128	1,978	2,170	0	4,276	
	Standard Error:	89.3	322.2	334.1	0.0		
Male:	Number in Sample:	0	66	49	1	116	
	Estimated % of Escapement:	0.0	36.1	26.8	0.5	63.4	
	Estimated Escapement:	0	4,212	3,127	64	7,403	
	Standard Error:	0.0	412.4	380.3	63.3		
Total:	Number in Sample:	2	97	83	1	183	
	Estimated % of Escapement:	1.1	53.0	45.4	0.5	100.0	
	Estimated Escapement:	128	6,191	5,297	64	11,679	
	Standard Error:	89.3	428.7	427.6	63.3		

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		Brood Year and Group				
		2003	2002	2001	2000	
		0.2	0.3	0.4	0.5	Total
Stratum 6: 07/23 - 07/29						
Sampling Dates: 7/23-25						
Female:	Number in Sample:	1	59	30	0	90
	Estimated % of Escapement:	0.5	31.1	15.8	0.0	47.4
	Estimated Escapement:	21	1,225	623	0	1,869
	Standard Error:	20.3	129.5	102.1	0.0	
Male:	Number in Sample:	3	53	42	2	100
	Estimated % of Escapement:	1.6	27.9	22.1	1.1	52.6
	Estimated Escapement:	62	1,100	872	42	2,076
	Standard Error:	34.9	125.6	116.2	28.6	
Total:	Number in Sample:	4	112	72	2	190
	Estimated % of Escapement:	2.1	58.9	37.9	1.1	100.0
	Estimated Escapement:	83	2,325	1,495	42	3,945
	Standard Error:	40.2	137.7	135.8	28.6	
Stratum 7: 07/30 - 08/05						
Sampling Dates:7/20-8/1						
Female:	Number in Sample:	12	88	31	0	131
	Estimated % of Escapement:	5.5	40.4	14.2	0.0	60.1
	Estimated Escapement:	158	1,160	409	0	1,727
	Standard Error:	42.8	92.0	65.5	0.0	
Male:	Number in Sample:	7	47	33	0	87
	Estimated % of Escapement:	3.2	21.6	15.1	0.0	39.9
	Estimated Escapement:	92	620	435	0	1,147
	Standard Error:	33.1	77.1	67.2	0.0	
Total:	Number in Sample:	19	135	64	0	218
	Estimated % of Escapement:	8.7	61.9	29.4	0.0	100.0
	Estimated Escapement:	250	1,780	844	0	2,874
	Standard Error:	52.9	91.1	85.4	0.0	
Strata 8-11: 08/06 - 09/10						
Sampling Dates: 8/6-8/8,13,15,22,27,28,9/3						
Female:	Number in Sample:	16	73	31	0	120
	Estimated % of Escapement:	7.2	32.9	14.0	0.0	54.1
	Estimated Escapement:	172	785	333	0	1,290
	Standard Error:	39.5	71.8	53.0	0.0	
Male:	Number in Sample:	6	57	39	0	102
	Estimated % of Escapement:	2.7	25.7	17.6	0.0	45.9
	Estimated Escapement:	65	613	419	0	1,097
	Standard Error:	24.8	66.8	58.2	0.0	
Total:	Number in Sample:	22	130	70	0	222
	Estimated % of Escapement:	9.9	58.6	31.5	0.0	100.0
	Estimated Escapement:	237	1,398	753	0	2,387
	Standard Error:	45.7	75.3	71.1	0.0	

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		Brood Year and Group				
		2003	2002	2001	2000	
		0.2	0.3	0.4	0.5	Total
Strata 1-13:	06/18 - 09/16					
Sampling Dates:						
Female:	Number in Sample:	31	319	209	0	559
	% Females in Age Group:	2.5	50.1	47.4	0.0	100.0
	Estimated % of Escapement:	1.0	20.6	19.5	0.0	41.1
	Estimated Escapement:	479	9,787	9,262	0	19,527 *
	Standard Error:	108.5	625.1	659.8	0.0	
	Estimated Design Effects:	0.652	1.294	1.500	0.000	1.421
Male:	Number in Sample:	16	316	306	3	641
	% Males in Age Group:	0.8	46.2	52.6	0.4	100.0
	Estimated % of Escapement:	0.5	27.2	31.0	0.2	58.9
	Estimated Escapement:	219	12,917	14,721	105	27,963 *
	Standard Error:	54.1	724.5	766.1	69.5	
	Estimated Design Effects:	0.364	1.434	1.484	1.184	1.421
Total:	Number in Sample:	47	635	515	3	1,200
	Estimated % of Escapement:	1.5	47.8	50.5	0.2	100.0
	Estimated Escapement:	698	22,704	23,983	105	47,490 *
	Standard Error:	120.3	805.4	803.5	69.5	
	Estimated Design Effects:	0.556	1.407	1.397	1.184	

* Includes estimates of 167 in stratum one, 2,753 in stratum two, and 2,183 in stratum three.

APPENDIX 4.―Estimated length (mm) at age composition of weekly chum salmon escapements through the Kwethluk River weir, Alaska, 2006.

			Brood Year and Age Class			
			2003	2002	2001	2000
			0.2	0.3	0.4	0.5
Strata 1-3:	6/18-7/8					
Sampling Dates:	07/05 07/06 07/07					
Male:		Mean Length		582	597	
		Std. Error		4	4	
		Range		515- 635	510- 675	
		Sample Size	0	43	81	0
Female:		Mean Length		556	569	
		Std. Error		5	4	
		Range		495- 595	520- 630	
		Sample Size	0	27	47	0
Stratum 4:	7/9-7/15					
Sampling Dates:	07/09 07/11 07/12					
Male:		Mean Length		574	585	
		Std. Error		4	5	
		Range		525- 645	455- 680	
		Sample Size	0	49	62	0
Female:		Mean Length		554	561	
		Std. Error		4	4	
		Range		515- 620	500- 615	
		Sample Size	0	41	36	0
Stratum 5:	7/16-7/22					
Sampling Date:	7/16					
Male:		Mean Length		577	588	623
		Std. Error		4	5	8
		Range		520- 645	525- 655	615- 630
		Sample Size	0	65	49	2
Female:		Mean Length	550	557	569	
		Std. Error	10	4	4	
		Range	540- 560	520- 590	520- 620	
		Sample Size	2	31	34	0
Stratum 6:	7/23-7/29					
Sampling Dates:	07/23 07/24 07/25					
Male:		Mean Length	503	567	585	638
		Std. Error	6	4	5	13
		Range	495- 515	500- 635	530- 655	625- 650
		Sample Size	3	53	42	2
Female:		Mean Length	525	541	555	
		Std. Error	.	4	6	
		Range	525- 525	495- 620	500- 620	
		Sample Size	1	59	30	0

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		Brood Year and Age Class			
		2003	2002	2001	2000
		0.2	0.3	0.4	0.5
Stratum 7:	7/30-8/5				
Sampling Dates:	07/30 07/31 08/01				
Male:	Mean Length	526	565	573	
	Std. Error	6	4	6	
	Range	505- 545	500- 635	510- 635	
	Sample Size	7	47	33	0
Female:	Mean Length	512	528	529	
	Std. Error	7	3	5	
	Range	490- 565	470- 605	475- 595	
	Sample Size	12	88	31	0
Strata 8-12:	8/6-9/9				
Sampling Dates:	08/06-09/03				
Male:	Mean Length	508	561	568	
	Std. Error	10	4	4	
	Range	485- 555	490- 635	515- 610	
	Sample Size	6	55	39	0
Female:	Mean Length	517	530	547	
	Std. Error	5	3	4	
	Range	475- 545	460- 605	500- 590	
	Sample Size	16	74	31	0
Season: Strata 1-12:	6/18-9/9				
Male:	Mean Length	514	575	590	626
	Std. Error	4	2	2	6
	Range	485- 555	490- 645	455- 680	615- 650
	Sample Size	16	312	306	4
Female:	Mean Length	524	548	563	
	Std. Error	4	2	2	
	Range	475- 565	460- 620	475- 630	
	Sample Size	31	320	209	0

APPENDIX 5.—Results for *t-tests* (assuming unequal variance) for difference in mean length-at-age between male and female age classes with sufficient data for analysis, for chum, Chinook, and coho salmon at the Kwethluk River weir, Alaska, 2006.

Chum Salmon

Age	0.2		0.3		0.4	
	Male	Female	Male	Female	Male	Female
Mean	515	517	572	539	585	557
Variance	452	483	968	843	1123	879
Observations	16	31	315	320	306	209
Hypothesized Mean Difference	0		0		0	
df	31		628		480	
t Stat	-0.41		13.57		10.25	
P(T<=t) two-tail	0.68		<0.001		<0.001	
t Critical two-tail	2.04		1.96		1.96	

Chinook Salmon

Age	1.3		1.4		1.5	
	Male	Female	Male	Female	Male	F
Mean	691	766	811	861	809	865
Variance	4795	4089	6359	2392	6585	1945
Observations	166	38	85	333	14	36
Hypothesized Mean Difference	0		0		0	
df	59		101		16	
t Stat	-6.43		-5.49		-2.47	
P(T<=t) two-tail	<0.001		<0.001		0.025	
t Critical two-tail	2.00		1.98		2.12	

Coho Salmon

Age	1.1		2.1	
	Male	Female	Male	Female
Mean	524	521	538	538
Variance	1600	610	1368	860
Observations	77	45	397	261
Hypothesized Mean Difference	0		0	
df	120		633	
t Stat	0.50		0.09	
P(T<=t) two-tail	0.62		0.92	
t Critical two-tail	1.98		1.96	

APPENDIX 6.—Estimated age and sex composition of weekly Chinook salmon escapements through the Kwethluk River weir, Alaska, 2006, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group						
		2003	2002	2001	2000	1999		
		1.1	1.2	1.3	1.4	1.5	Total	
Strata 1-3:	06/18 - 07/08							
Sampling Dates: 7/5-7/8								
Female:	Number in Sample:	0	0	5	59	6	70	
	Estimated % of Escapement:	0.0	0.0	2.6	30.3	3.1	35.9	
	Estimated Escapement:	0	0	212	2,500	254	2,966	*
	Standard Error:	0.0	0.0	92.7	269.3	101.2		
Male:	Number in Sample:	1	80	36	6	2	125	
	Estimated % of Escapement:	0.5	41.0	18.5	3.1	1.0	64.1	
	Estimated Escapement:	42	3,390	1,525	254	85	5,297	*
	Standard Error:	41.9	288.3	227.4	101.2	59.1		
Total:	Number in Sample:	1	80	41	65	8	195	
	Estimated % of Escapement:	0.5	41.0	21.0	33.3	4.1	100.0	
	Estimated Escapement:	42	3,390	1,737	2,754	339	8,263	*
	Standard Error:	41.9	288.3	238.9	276.3	116.3		
Stratum 4:	07/09 - 07/15							
Sampling Dates: 7/9-7/13								
Female:	Number in Sample:	0	0	4	57	4	65	
	Estimated % of Escapement:	0.0	0.0	2.1	29.5	2.1	33.7	
	Estimated Escapement:	0	0	76	1,076	76	1,227	
	Standard Error:	0.0	0.0	36.5	116.8	36.5		
Male:	Number in Sample:	1	54	48	24	1	128	
	Estimated % of Escapement:	0.5	28.0	24.9	12.4	0.5	66.3	
	Estimated Escapement:	19	1,020	906	453	19	2,417	
	Standard Error:	18.4	114.9	110.6	84.5	18.4		
Total:	Number in Sample:	1	54	52	81	5	193	
	Estimated % of Escapement:	0.5	28.0	26.9	42.0	2.6	100.0	
	Estimated Escapement:	19	1,020	982	1,529	94	3,644	
	Standard Error:	18.4	114.9	113.5	126.3	40.7		
Stratum 5:	07/16 - 07/22							
Sampling Dates: 7/16-7/18								
Female:	Number in Sample:	0	1	11	73	8	93	
	Estimated % of Escapement:	0.0	0.5	5.6	37.4	4.1	47.7	
	Estimated Escapement:	0	18	196	1,300	142	1,656	
	Standard Error:	0.0	17.3	55.9	117.2	48.0		
Male:	Number in Sample:	0	36	34	27	5	102	
	Estimated % of Escapement:	0.0	18.5	17.4	13.8	2.6	52.3	
	Estimated Escapement:	0	641	605	481	89	1,816	
	Standard Error:	0.0	94.0	91.9	83.6	38.3		
Total:	Number in Sample:	0	37	45	100	13	195	
	Estimated % of Escapement:	0.0	19.0	23.1	51.3	6.7	100.0	
	Estimated Escapement:	0	659	801	1,781	231	3,472	
	Standard Error:	0.0	95.0	102.0	121.0	60.4		

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		Brood Year and Age Group					
		2003	2002	2001	2000	1999	
		1.1	1.2	1.3	1.4	1.5	Total
Stratum 6:	07/23 - 07/29						
Sampling Dates: 7/23-7/26							
Female:	Number in Sample:	0	0	8	83	12	103
	Estimated % of Escapement:	0.0	0.0	4.1	42.8	6.2	53.1
	Estimated Escapement:	0	0	57	594	86	737
	Standard Error:	0.0	0.0	18.4	45.8	22.3	
Male:	Number in Sample:	0	51	27	13	0	91
	Estimated % of Escapement:	0.0	26.3	13.9	6.7	0.0	46.9
	Estimated Escapement:	0	365	193	93	0	651
	Standard Error:	0.0	40.8	32.1	23.2	0.0	
Total:	Number in Sample:	0	51	35	96	12	194
	Estimated % of Escapement:	0.0	26.3	18.0	49.5	6.2	100.0
	Estimated Escapement:	0	365	250	687	86	1,388
	Standard Error:	0.0	40.8	35.6	46.3	22.3	
Stratum 7:	07/30 - 08/05						
Sampling Dates: 7/30-8/5							
Female:	Number in Sample:	0	0	6	49	3	58
	Estimated % of Escapement:	0.0	0.0	5.3	43.0	2.6	50.9
	Estimated Escapement:	0	0	31	256	16	303
	Standard Error:	0.0	0.0	11.2	24.9	8.1	
Male:	Number in Sample:	0	24	16	12	4	56
	Estimated % of Escapement:	0.0	21.1	14.0	10.5	3.5	49.1
	Estimated Escapement:	0	125	84	63	21	292
	Standard Error:	0.0	20.5	17.5	15.4	9.3	
Total:	Number in Sample:	0	24	22	61	7	114
	Estimated % of Escapement:	0.0	21.1	19.3	53.5	6.1	100.0
	Estimated Escapement:	0	125	115	318	37	595
	Standard Error:	0.0	20.5	19.9	25.1	12.1	
Strata 8-10:	08/06 - 08/26						
Sampling Dates: 8/6--8/22							
Female:	Number in Sample:	0	0	4	11	3	18
	Estimated % of Escapement:	0.0	0.0	12.5	34.4	9.4	56.3
	Estimated Escapement:	0	0	32	88	24	144
	Standard Error:	0.0	0.0	14.2	20.4	12.5	
Male:	Number in Sample:	0	3	5	4	2	14
	Estimated % of Escapement:	0.0	9.4	15.6	12.5	6.3	43.8
	Estimated Escapement:	0	24	40	32	16	112
	Standard Error:	0.0	12.5	15.6	14.2	10.4	
Total:	Number in Sample:	0	3	9	15	5	32
	Estimated % of Escapement:	0.0	9.4	28.1	46.9	15.6	100.0
	Estimated Escapement:	0	24	72	120	40	256
	Standard Error:	0.0	12.5	19.3	21.5	15.6	

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		Brood Year and Age Group						
		2003	2002	2001	2000	1999		
		1.1	1.2	1.3	1.4	1.5	Total	
Strata 1 - 10: 06/18 - 08/26								
Sampling Dates:								
Female:	Number in Sample:	0	1	38	332	36	407	
	% Females in Age Group:	0.0	0.3	8.6	82.7	8.5	100.0	
	Estimated % of Escapement:	0.0	0.1	3.4	33.0	3.4	39.9	
	Estimated Escapement:	0	18	604	5,814	598	7,033	*
	Standard Error:	0.0	17.3	117.1	321.0	120.9		
	Estimated Design Effects:	0.000	0.933	1.282	1.436	1.376	1.433	
Male:	Number in Sample:	2	248	166	86	14	516	
	% Males in Age Group:	0.6	52.6	31.7	13.0	2.2	100.0	
	Estimated % of Escapement:	0.3	31.6	19.0	7.8	1.3	60.1	
	Estimated Escapement:	61	5,565	3,354	1,376	230	10,585	*
	Standard Error:	45.7	327.7	272.0	159.2	74.1		
	Estimated Design Effects:	1.845	1.527	1.478	1.097	1.319	1.433	
Total:	Number in Sample:	2	249	204	418	50	923	
	Estimated % of Escapement:	0.3	31.7	22.5	40.8	4.7	100.0	
	Estimated Escapement:	61	5,582	3,958	7,189	827	17,618	*
	Standard Error:	45.7	328.0	287.1	332.0	140.4		
	Estimated Design Effects:	1.845	1.527	1.458	1.407	1.361		

* Includes estimates of 18 in stratum one, 1, 2,033 in stratum two, and 1,443 in stratum three.

APPENDIX 7.–Estimated length (mm) at age composition of weekly Chinook salmon escapements through the Kwethluk River weir, Alaska, 2006.

		Brood Year and Age Class				
		2003	2002	2001	2000	1999
		1.1	1.2	1.3	1.4	1.5
Strata 1-3:	6/18-7/8					
Sampling Dates:	7/5-7/8					
Male:	Mean Length	475	560	669	730	788
	Std. Error		5	10	24	23
	Range	475- 475	450- 685	515- 795	620- 785	765- 810
	Sample Size	1	80	36	6	2
Female:	Mean Length			778	854	873
	Std. Error			23	7	13
	Range			720- 845	685- 940	835- 920
	Sample Size	0	0	5	59	6
Stratum 4:	7/9-7/15					
Sampling Dates:	7/9-7/13					
Male:	Mean Length	475	564	689	817	915
	Std. Error		6	9	17	
	Range	475- 475	435- 660	495- 810	635- 990	915- 915
	Sample Size	1	54	48	24	1
Female:	Mean Length			788	864	874
	Std. Error			9	5	20
	Range			770- 810	775- 960	830- 925
	Sample Size	0	0	4	57	4
Stratum 5:	7/16-7/22					
Sampling Dates:	7/16-7/18					
Male:	Mean Length		579	696	835	810
	Std. Error		11	12	15	29
	Range		475- 855	560- 825	700-1040	750- 915
	Sample Size	0	36	34	27	5
Female:	Mean Length		625	757	866	861
	Std. Error			16	6	23
	Range		625- 625	665- 855	685- 980	730- 915
	Sample Size	0	1	11	73	8
Stratum 6:	7/23-7/29					
Sampling Dates:	7/23-7/26					
Male:	Mean Length		561	687	782	
	Std. Error		6	13	17	
	Range		445- 645	545- 795	695- 890	
	Sample Size	0	51	27	13	0
Female:	Mean Length			773	861	861
	Std. Error			21	5	10
	Range			685- 855	705- 970	785- 905
	Sample Size	0	0	8	83	12

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		Brood Year and Age Class				
		2003	2002	2001	2000	1999
		1.1	1.2	1.3	1.4	1.5
Strata 7-8:	7/30-8/5					
Sampling Dates: 7/30-8/9						
Male:	Mean Length		547	727	816	798
	Std. Error		10	18	19	43
	Range		445- 660	535- 855	695- 960	610- 920
	Sample Size	0	27	21	15	6
Female:	Mean Length			754	857	866
	Std. Error			30	6	22
	Range			570- 835	740- 970	795- 955
	Sample Size	0	0	10	61	6
Strata 1-8:	6/18-8/12					
Male:	Mean Length	475	563	683	805	808
	Std. Error		3	6	9	17
	Range	475- 475	435- 855	495- 855	620-1040	610- 920
	Sample Size	2	248	166	85	14
Female:	Mean Length		625	770	860	868
	Std. Error			11	4	9
	Range		625- 625	570- 855	685- 980	730- 955
	Sample Size	0	1	38	333	36

APPENDIX 8.—Estimated age and sex composition of weekly sockeye salmon escapements through the Kwethluk River weir, Alaska, 2006, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		2002	2002	2001	2000	
		0.3	1.2	1.3	1.4	Total
Strata 1-3: 06/18 - 07/08						
Sampling Dates: 7/5-7/8						
Female:	Number in Sample:	0	4	9	0	13
	Estimated % of Escapement:	0.0	10.0	22.5	0	32.5
	Estimated Escapement:	0	436	980	0	1,416 *
	Standard Error:	0.0	208.3	289.9	0	
Male:	Number in Sample:	0	5	22	0	27
	Estimated % of Escapement:	0.0	12.5	55.0	0	67.5
	Estimated Escapement:	0	545	2,396	0	2,940 *
	Standard Error:	0.0	229.6	345.4	0	
Total:	Number in Sample:	0	9	31	0	40
	Estimated % of Escapement:	0.0	22.5	77.5	0	100
	Estimated Escapement:	0	980	3,376	0	4,356 *
	Standard Error:	0.0	289.9	289.9	0	
Strata 4 - 6: 07/09 - 07/29						
Sampling Dates: 7/9-7/27						
Female:	Number in Sample:	0	1	15	0	16
	Estimated % of Escapement:	0.0	2.9	44.1	0	47
	Estimated Escapement:	0	58	869	0	927
	Standard Error:	0.0	57.4	168.8	0	
Male:	Number in Sample:	0	10	8	0	18
	Estimated % of Escapement:	0.0	29.4	23.5	0	53
	Estimated Escapement:	0	579	464	0	1,043
	Standard Error:	0.0	154.9	144.2	0	
Total:	Number in Sample:	0	11	23	0	34
	Estimated % of Escapement:	0.0	32.4	67.6	0	100
	Estimated Escapement:	0	637	1,333	0	1,970
	Standard Error:	0.0	159.0	159.0	0	
Strata 7-10: 07/30 - 08/26						
Sampling Dates: 7/30-8/22						
Female:	Number in Sample:	1	7	9	0	17
	Estimated % of Escapement:	2.3	15.9	20.5	0	39
	Estimated Escapement:	9	65	83	0	157
	Standard Error:	8.7	21.4	23.6	0	
Male:	Number in Sample:	0	14	12	1	27
	Estimated % of Escapement:	0.0	31.8	27.3	2	61
	Estimated Escapement:	0	130	111	9	250
	Standard Error:	0.0	27.3	26.1	9	
Total:	Number in Sample:	1	21	21	1	44
	Estimated % of Escapement:	2.3	47.7	47.7	2	100
	Estimated Escapement:	9	194	194	9	407
	Standard Error:	8.7	29.3	29.3	8.7	

APPENDIX 8.–(Page 2 of 2)

		Brood Year and Age Group				
		2002	2002	2001	2000	
		0.3	1.2	1.3	1.4	Total
Strata 1 - 10: 06/18 - 08/26						
Sampling Dates:						
Female:	Number in Sample:	1	12	33	0	46
	% Females in Age Group:	0.4	22.3	77.3	0	100.0
	Estimated % of Escapement:	0.1	8.3	28.7	0	37.1
	Estimated Escapement:	9	558	1,932	0	2,500 *
	Standard Error:	8.7	217.1	336.3	0	
	Estimated Design Effects:	0.161	1.618	1.444	0	1.514
Male:	Number in Sample:	0	29	42	1	72
	% Males in Age Group:	0.0	29.6	70.2	0	100.0
	Estimated % of Escapement:	0.0	18.6	44.1	0	62.9
	Estimated Escapement:	0	1,253	2,970	9	4,233 *
	Standard Error:	0.0	278.3	375.2	9	
	Estimated Design Effects:	0.000	1.337	1.490	0	1.514
Total:	Number in Sample:	1	41	75	1	118
	Estimated % of Escapement:	0.1	26.9	72.8	0	100.0
	Estimated Escapement:	9	1,812	4,903	9	6,733 *
	Standard Error:	8.7	332.0	332.0	9	
	Estimated Design Effects:	0.161	1.464	1.454	0	

* Includes estimates of 234 in stratum one, 1,712 in stratum two and 2,410 in stratum four.

APPENDIX 9.–Estimated length (mm) at age composition of weekly sockeye salmon escapements through the Kwethluk River weir, Alaska, 2006.

		Brood Year and Age Group							
			2002		2002		2001		2000
			0.3		1.2		1.3		1.4
Strata 1-3:	6/18-7/8								
Sampling Dates: 7/5-7/8									
Male:	Mean Length				533		570		
	Std. Error				16		5		
	Range			495-	570	530-	600		
	Sample Size		0		5		22		0
Female:	Mean Length				523		541		
	Std. Error				11		5		
	Range			500-	550	520-	560		
	Sample Size		0		4		9		0
Strata 4-6:	7/9-7/29								
Sampling Dates: 7/9-7/27									
Male:	Mean Length				542		563		
	Std. Error				10		7		
	Range			500-	595	535-	595		
	Sample Size		0		10		8		0
Female:	Mean Length				515		528		
	Std. Error						6		
	Range			515-	515	455-	565		
	Sample Size		0		1		21		0
Strata 7-10:	7/30-8/26								
Sampling Dates: 7/5-8/22									
Male:	Mean Length				541		586		615
	Std. Error				11		7		
	Range			455-	580	570-	615	615-	615
	Sample Size		0		14		6		1
Female:	Mean Length		540		525		533		
	Std. Error		.		2		9		
	Range	540-	540	515-	530	492-	575		
	Sample Size		1		7		9		0
Strata 1-10:	6/18-8/26								
Sampling Dates: 7/5-8/22									
Male:	Mean Length				537		569		615
	Std. Error				9		4		
	Range			455-	595	530-	615	615-	615
	Sample Size		0		29		36		1
Female:	Mean Length		540		522		535		
	Std. Error				10		4		
	Range	540-	540	500-	550	455-	575		
	Sample Size		1		12		39		0

APPENDIX 10.—Estimated age and sex composition of weekly coho salmon escapements through the Kwethluk River weir, Alaska, 2006, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group			
		2003	2002	2001	
		1.1	2.1	3.1	Total
Strata 1-7:	06/18 - 08/05				
Sampling Dates: 7/12-8/5					
Female:	Number in Sample:	8	31	3	42
	Estimated % of Escapement:	8.7	33.7	3.3	45.7
	Estimated Escapement:	157	609	59	825
	Standard Error:	52.0	87.2	32.8	
Male:	Number in Sample:	10	36	4	50
	Estimated % of Escapement:	10.9	39.1	4.3	54.3
	Estimated Escapement:	196	707	79	982
	Standard Error:	57.4	90.1	37.6	
Total:	Number in Sample:	18	67	7	92
	Estimated % of Escapement:	19.6	72.8	7.6	100.0
	Estimated Escapement:	354	1,316	137	1,807
	Standard Error:	73.2	82.1	48.9	
Stratum 8:	08/06 - 08/12				
Sampling Dates: 8/6-8/9					
Female:	Number in Sample:	10	55	2	67
	Estimated % of Escapement:	6.8	37.7	1.4	45.9
	Estimated Escapement:	181	997	36	1,214
	Standard Error:	54.0	103.5	24.8	
Male:	Number in Sample:	13	62	4	79
	Estimated % of Escapement:	8.9	42.5	2.7	54.1
	Estimated Escapement:	236	1,124	72	1,432
	Standard Error:	60.8	105.6	34.9	
Total:	Number in Sample:	23	117	6	146
	Estimated % of Escapement:	15.8	80.1	4.1	100.0
	Estimated Escapement:	417	2,120	109	2,646
	Standard Error:	77.8	85.2	42.4	
Stratum 9:	08/13 - 08/19				
Sampling Dates: 8/13-8/15					
Female:	Number in Sample:	12	44	2	58
	Estimated % of Escapement:	8.1	29.7	1.4	39.2
	Estimated Escapement:	395	1,450	66	1,911
	Standard Error:	108.1	181.0	45.7	
Male:	Number in Sample:	14	76	0	90
	Estimated % of Escapement:	9.5	51.4	0.0	60.8
	Estimated Escapement:	461	2,504	0	2,966
	Standard Error:	115.9	198.0	0.0	
Total:	Number in Sample:	26	120	2	148
	Estimated % of Escapement:	17.6	81.1	1.4	100.0
	Estimated Escapement:	857	3,954	66	4,877
	Standard Error:	150.7	155.1	45.7	

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		Brood Year and Age Group			
		2004	2003	2002	
		1.1	2.1	3.1	Total
Stratum 10: 08/20 - 08/26					
Sampling Dates: 8/22					
Female:	Number in Sample:	3	44	2	49
	Estimated % of Escapement:	2.1	30.8	1.4	34.3
	Estimated Escapement:	135	1,982	90	2,208 *
	Standard Error:	76.6	246.8	62.8	
Male:	Number in Sample:	15	74	5	94
	Estimated % of Escapement:	10.5	51.7	3.5	65.7
	Estimated Escapement:	676	3,334	225	4,235 *
	Standard Error:	163.8	267.2	98.2	
Total:	Number in Sample:	18	118	7	143
	Estimated % of Escapement:	12.6	82.5	4.9	100.0
	Estimated Escapement:	811	5,317	315	6,443 *
	Standard Error:	177.3	203.1	115.4	
Stratum 11: 08/27 - 09/02					
Sampling Dates:8/27-8/28					
Female:	Number in Sample:	5	38	0	43
	Estimated % of Escapement:	3.7	27.9	0.0	31.6
	Estimated Escapement:	214	1,627	0	1,841 *
	Standard Error:	93.2	222.2	0.0	
Male:	Number in Sample:	13	77	3	93
	Estimated % of Escapement:	9.6	56.6	2.2	68.4
	Estimated Escapement:	557	3,296	128	3,981 *
	Standard Error:	145.6	245.4	72.7	
Total:	Number in Sample:	18	115	3	136
	Estimated % of Escapement:	13.2	84.6	2.2	100.0
	Estimated Escapement:	771	4,923	128	5,822 *
	Standard Error:	167.8	178.9	72.7	
Strata 12-13: 09/03 - 09/16					
Sampling Dates: 9/3					
Female:	Number in Sample:	5	49	1	55
	Estimated % of Escapement:	3.6	35.0	0.7	39.3
	Estimated Escapement:	145	1,421	29	1,595 *
	Standard Error:	62.8	161.4	28.5	
Male:	Number in Sample:	13	72	0	85
	Estimated % of Escapement:	9.3	51.4	0.0	60.7
	Estimated Escapement:	377	2,087	0	2,464 *
	Standard Error:	98.2	169.1	0.0	
Total:	Number in Sample:	18	121	1	140
	Estimated % of Escapement:	12.9	86.4	0.7	100.0
	Estimated Escapement:	522	3,508	29	4,059 *
	Standard Error:	113.2	115.9	28.5	

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		Brood Year and Age Group			
		2004	2003	2002	
		0.0	0.0	0.0	Total
Strata 1 - 13: 06/18 - 09/16					
Sampling Dates:					
Female:	Number in Sample:	43	261	10	314
	% Females in Age Group:	12.8	84.3	2.9	100.0
	Estimated % of Escapement:	4.8	31.5	1.1	37.4
	Estimated Escapement:	1,228	8,085	280	9,594 *
	Standard Error:	189.2	432.9	92.4	
	Estimated Design Effects:	0.991	1.092	0.997	1.085
Male:	Number in Sample:	78	397	16	491
	% Males in Age Group:	15.6	81.3	3.1	100.0
	Estimated % of Escapement:	9.8	50.9	2.0	62.6
	Estimated Escapement:	2,503	13,053	505	16,060 *
	Standard Error:	279.5	467.6	132.5	
	Estimated Design Effects:	1.116	1.100	1.144	1.085
Total:	Number in Sample:	121	658	26	805
	Estimated % of Escapement:	14.5	82.4	3.1	100.0
	Estimated Escapement:	3,731	21,138	785	25,654 *
	Standard Error:	326.4	353.2	160.3	
	Estimated Design Effects:	1.079	1.082	1.089	

* Includes estimates of 3,049 in stratum ten, 1,293 in stratum eleven, 1,083 in stratum twelve and 1,008 in stratum thirteen.

APPENDIX 11.–Estimated length (mm) at age composition of weekly coho salmon escapements through the Kwethluk River weir, Alaska, 3006.

		Brood Year and Age Group		
		2003	2002	2001
		1.1	2.1	3.1
Strata 1-7: 6/18-8/5				
Sampling Dates: 7/12-8/05				
Male:	Mean Length	528	531	505
	Std. Error	13	7	25
	Range	470- 585	405- 595	455- 560
	Sample Size	9	36	4
Female:	Mean Length	512	527	558
	Std. Error	8	6	9
	Range	480- 550	470- 600	545- 575
	Sample Size	10	31	3
Stratum 8: 8/06-8/12				
Sampling Dates: 8/06-8/12				
Male:	Mean Length	514	533	509
	Std. Error	9	5	18
	Range	460- 570	445- 615	455- 530
	Sample Size	13	62	4
Female:	Mean Length	527	536	558
	Std. Error	6	4	3
	Range	505- 565	450- 585	555- 560
	Sample Size	10	55	2
Stratum 9: 8/13-8/19				
Sampling Dates: 8/13-8/19				
Male:	Mean Length	514	527	
	Std. Error	7	4	
	Range	470- 555	445- 600	
	Sample Size	14	76	
Female:	Mean Length	520	527	510
	Std. Error	9	4	5
	Range	470- 565	485- 595	505- 515
	Sample Size	12	44	2
Stratum 10: 8/20-8/26				
Sampling Dates: 8/22				
Male:	Mean Length	520	545	567
	Std. Error	6	3	11
	Range	485- 560	480- 615	545- 610
	Sample Size	15	74	5
Female:	Mean Length	513	543	535
	Std. Error	16	4	20
	Range	490- 545	475- 595	515- 555
	Sample Size	3	44	2

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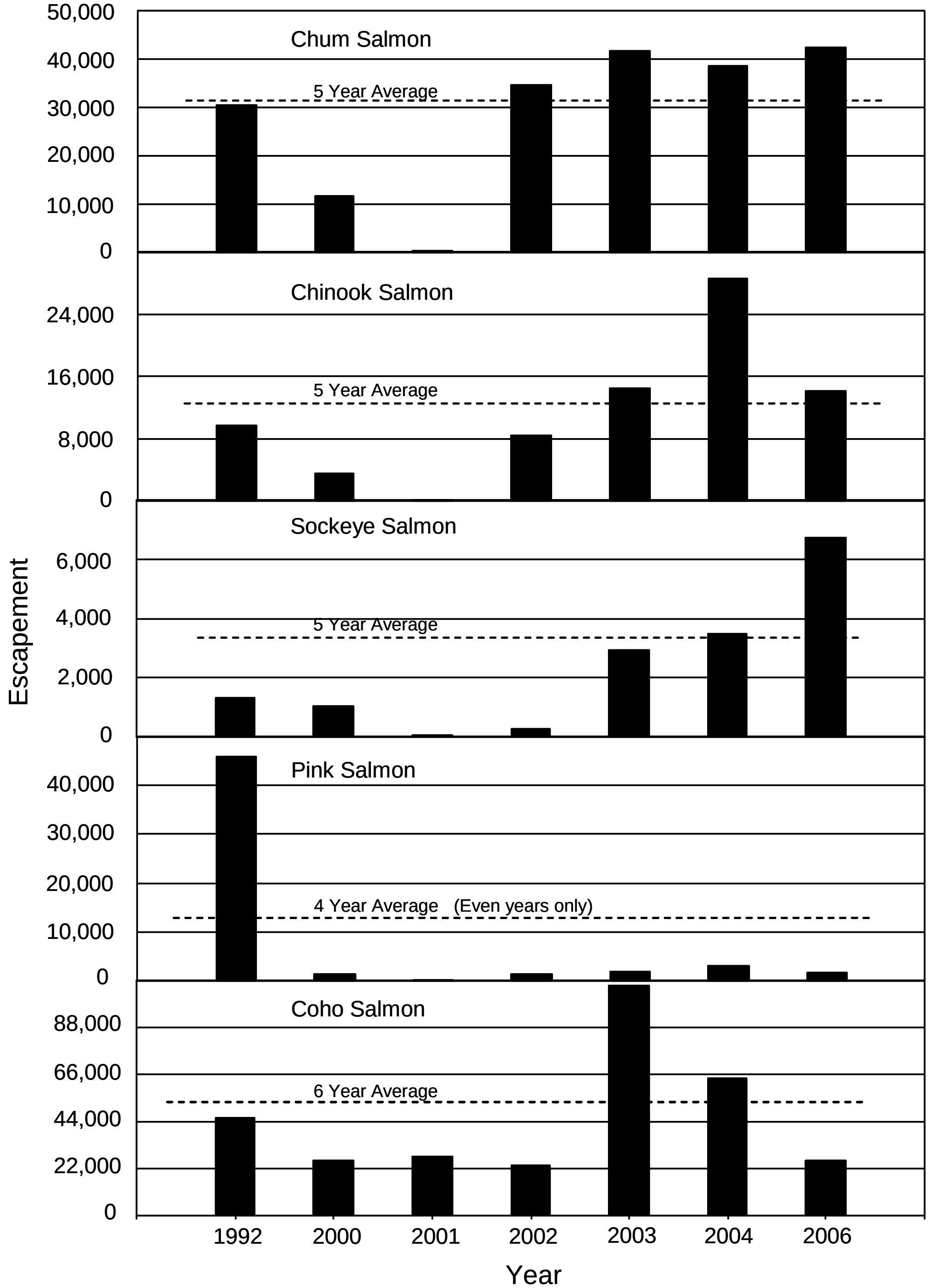
		Brood Year and Age Group		
		2003	2002	2001
		1.1	2.1	3.1
Stratum 11: 8/27-9/02				
Sampling Dates: 8/27-8/28				
Male:	Mean Length	503	544	572
	Std. Error	14	4	12
	Range	430- 560	435- 610	550- 590
	Sample Size	13	77	3
Female:	Mean Length	531	544	
	Std. Error	6	4	
	Range	510- 545	495- 600	
	Sample Size	5	38	
Strata 12-13: 9/03-9/16				
Sampling Dates: 9/3				
Male:	Mean Length	565	543	
	Std. Error	10	5	
	Range	500- 605	410- 635	
	Sample Size	13	72	
Female:	Mean Length	522	547	580
	Std. Error	13	4	
	Range	500- 555	495- 610	580- 580
	Sample Size	5	49	1
Strata 1-13: 6/18-9/16				
Sampling Dates: 7/12-9/3				
Male:	Mean Length	522	539	550
	Std. Error	4	2	7
	Range	430- 605	405- 635	455- 610
	Sample Size	77	397	16
Female:	Mean Length	521	539	542
	Std. Error	4	2	8
	Range	470- 565	450- 610	505- 580
	Sample Size	45	261	10



APPENDIX 12.—Estimates of salmon escapement through the Kwethluk River weir, Alaska, 1992, 2000-2004, and 2006. Enumeration for 2001 commenced on 8/12. Averages were calculated using years with complete counts. The y-axis uses different scales.