U.S. Fish & Wildlife Service

Abundance and Run Timing of Adult Pacific Salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2014

Alaska Fisheries Data Series Number 2015-7

Kenai Fish and Wildlife Field Office
Soldotna, Alaska
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Steve J. Miller, James K. Boersma and Ken C. Harper

Abstract

The Kenai Fish and Wildlife Field Office monitored the escapement of the five species of Pacific salmon *Oncorhynchus* spp. returning to the Tuluksak River, a tributary to the lower Kuskokwim River. From June 29 to September 12, 2014, a resistance board weir and an underwater video system were used to collect abundance, run timing, age, sex, and length data from returning adult salmon. These data support in-season and post-season management of commercial and subsistence fisheries that occur on the Yukon Delta National Wildlife Refuge and the Kuskokwim River. Estimated escapements of 8,726 Chum Salmon *O. keta*, 320 Chinook Salmon *O. tshawytscha*, 514 Sockeye Salmon *O. nerka*, 508 Pink Salmon *O. gorbuscha* and 13,797 Coho Salmon *O. kisutch* passed through the Tuluksak River weir during 2014. Peak weekly passage occurred June 29 to July 5 for Chinook, July 20–26 for Chum, July 13−19 for Sockeye and Pink, and August 24–30 for Coho salmon. Age, sex, and length data were collected for Chum, Chinook, Sockeye and Coho salmon. Dominant ages were 0.3 (68%) for Chum, 1.3 (48%) for Chinook, 1.3 (60%) for Sockeye and 2.1 (73%) for Coho salmon. Overall percentages of female salmon (ASL collection) were: Chum 41%, Chinook 30%, Sockeye 48%, and Coho salmon 37%. Mean lengths varied between male and female salmon for each species sampled. The estimated Chinook Salmon escapement of 320 during 2014 was well below a 17-year average of 1,048 for the ninth successive year. Special management actions taken for Chinook Salmon during 2014 were similar to 2012−2013 and included closure of the Tuluksak River to Chinook Salmon harvest.

Introduction

The Tuluksak River is located approximately 192 river kilometers (rkm) upstream from the mouth of the Kuskokwim River in western Alaska (Whitmore et al. 2005). It flows through the Yukon Delta National Wildlife Refuge (Refuge) and supports spawning populations of Chum Salmon *Oncorhynchus keta*, Chinook Salmon *O. tshawytscha*, Sockeye Salmon *O. nerka*, Pink Salmon *O. gorbuscha*, and Coho Salmon *O. kisutch*. These salmon have historically contributed to large subsistence and commercial fisheries in the lower Kuskokwim River drainage. In addition to human consumption, salmon provide food for brown bears and other carnivores, raptors and scavengers. These salmon also sustain resident fish species and salmon fry that rely heavily on the nutrients provided by salmon eggs and carcasses (U.S. Fish and Wildlife Service 1992).

Under guidelines established in the Policy for the management of sustainable salmon fisheries, 5 AAC 39.222, the Alaska Board of Fisheries designated Kuskokwim River Chum and Chinook

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salmon as stocks of yield concern in September 2000 and managed the fishery under those guidelines through 2006 (Bergstrom and Whitmore 2004; Linderman and Bue 2006). This designation was based upon the inability, despite specific management measures, to maintain expected yields or to have a stable surplus above the stock's escapement needs. Beginning in January 2001, the salmon fishery in the Kuskokwim River drainage was managed under the Kuskokwim River Salmon Rebuilding Management Plan (Ward et al. 2003; Bergstrom and Whitmore 2004). The yield concern designation was discontinued in 2007 after Chum and Chinook salmon escapements returned to levels considered sustainable (Linderman and Rearden 2007). The Alaska Board of Fisheries adopted a new Kuskokwim River Salmon Management Plan in January 2013. This plan establishes a new drainage-wide Sustainable Escapement Goal (SEG) of 65,000−120,000 Chinook Salmon and eliminated the SEG of 1,000−2,100 Chinook Salmon for the Tuluksak River (5 AAC 07.365; Conitz et al. 2012; Elison et al. 2012).

The Alaska Department of Fish and Game (Department), the U.S. Fish and Wildlife Service (Service), and the Kuskokwim River Salmon Management Working Group (Working Group) work together to achieve the goals of both the Kuskokwim River Salmon Management and the Federal Subsistence Fishery Management program. In addition to the goals set by the Department, Service, and the Working Group, the Alaska National Interest Lands Conservation Act (ANILCA) established the Yukon Delta National Wildlife Refuge in Alaska for the general purpose to: "conserve fish and wildlife populations and habitats in their natural diversity" (ANILCA 1980). Despite the conservation measures taken by area managers, Chinook Salmon returns to the Tuluksak River have been below the median of 737 fish for the past 8 years.

The broad geographic distribution of escapement monitoring projects in the Kuskokwim area provides insight for sustainable salmon management. Recent tagging studies conducted on Chum, Chinook, Sockeye, and Coho salmon have all demonstrated differential stock-specific run timing with a general pattern of salmon stocks from upper river tributaries entering the Kuskokwim River earliest, whereas stocks from lower river tributaries enter progressively later (Kerkvliet and Hamazaki 2003; Kerkvliet et al. 2003, 2004; Stuby 2006). The temporal stock-specific run timings overlap and the difference between the mid-point of one stock and another of the same species can be greater than two weeks. Concurrent with this phenomenon is the extensive subsistence fishery that more heavily harvests early arriving salmon, and commercial fisheries that have historically focused on early, middle, and late segments of the overall salmon run (Molyneaux et al. 2010).

This mixture of different stock-specific run timings and uneven distribution of harvest produce the possibility of significant differential exploitation rates between stocks. This situation mandates that managers develop and maintain a rigorous monitoring program capable of assessing escapement trends within the Kuskokwim River drainage. To manage for sustained yields and conservation of individual salmon stocks, managers need data on escapement, migratory timing, and sex and age composition.

In previous years, salmon escapements were monitored using aerial surveys as indices of relative abundance in the Tuluksak River. Aerial surveys started in 1965 and occurred sporadically until 2003 (Harper 1997; Ward et al. 2003; Whitmore et al. 2005). These surveys were used infrequently for in-season management of the Kuskokwim River fisheries because the surveys often occurred after the commercial and subsistence harvests.

A resistance board weir has been utilized to monitor salmon escapements on the Tuluksak River from 1991 to 1994 and from 2001 to 2014. After the 1994 season, the Tuluksak Native Community (TNC) opposed the weir. Budget constraints and the lack of TNC support caused

redirecting of funding to other projects and it was not operated from 1995 to 2000. With the designation of Chinook and Chum salmon as stocks of concern in January of 2000 and with the availability of funding since 2001, TNC and the Service cooperated in staffing and operating the weir until 2014. During 2014 State and Federal managers had conservation concerns similar to 2000. The preseason run forecast was less than necessary for an unrestricted harvest of Chinook Salmon to meet anticipated needs of subsistence users. Restrictions implemented by managers to conserve the Kuskokwim River Chinook Salmon population were met with resistance by local communities and subsistence users.

Study Area

The Tuluksak River is one of several lower Kuskokwim River tributaries and flows into the lower Kuskokwim River at River Kilometer 192. It is approximately 66 river kilometers (rkm) east-northeast of Bethel, Alaska (Whitmore et al. 2005). The Tuluksak River is approximately 137 rkm in length and its watershed encompasses approximately 2,098 km^2 (Figure 1). It originates in the Kilbuck Mountains and flows to the northwest. The Fog River drains into the lower portion of the Tuluksak River and is the only major tributary. The Tuluksak River is a medium gradient river for the majority of its length and is characterized by dense overhanging vegetation and cut banks. The lower river is characterized by low gradient, silt substrate, and turbid water. The river at the weir site is approximately 49 rkm from its confluence with the Kuskokwim River, is 42 m wide, shallowest in mid-river, and deepest near the banks. The substrate contains primarily sand mixed with fine gravel. Water clarity is moderately clear, but becomes turbid during rainy periods and when boat traffic is present.

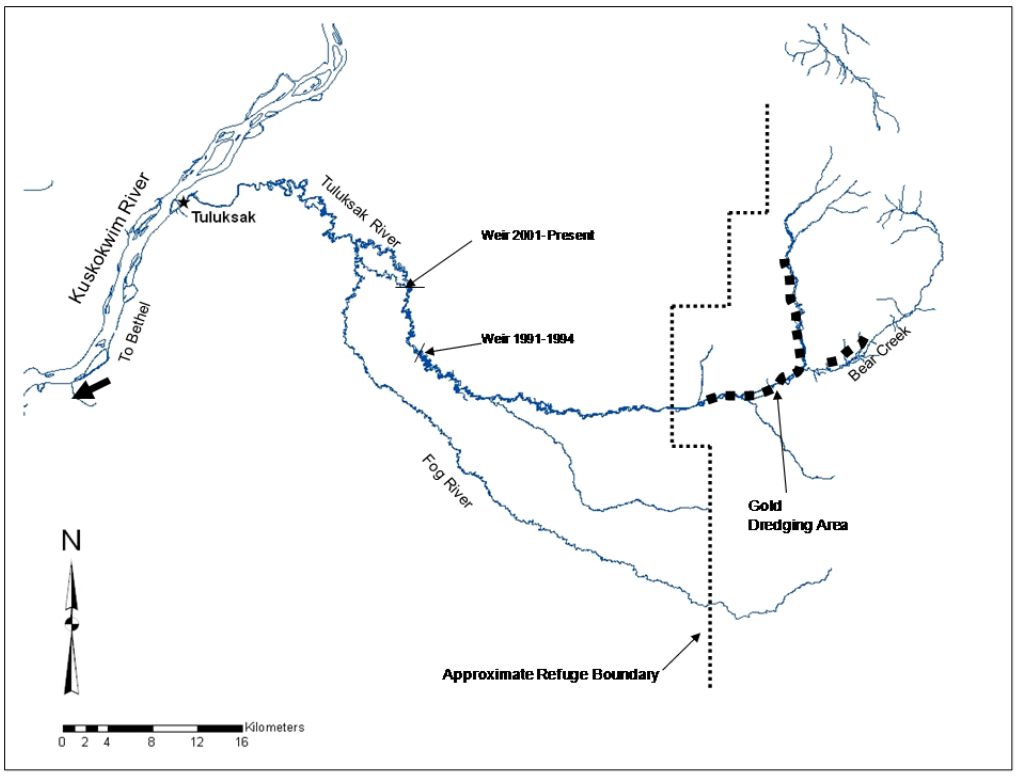

FIGURE 1.—Tuluksak River weir location, Yukon Delta National Wildlife Refuge, 1991–1994, and 2001–2014. The current weir location is 49 rkm upstream from the confluence with the Kuskokwim River. Black squares represent areas where dredge equipment operated in the floodplain of the Tuluksak River.

Dredging has taken place in approximately 40 km of the upper Tuluksak River and Bear Creek drainages upstream of the Refuge boundary (Figure 1). Dredge equipment operating in the

floodplain of the Tuluksak River has altered the stream channel, and water in some areas flows through dredge tailings, tailing ponds, or both. The mining and dredging activities, which began in 1908 and continued through most of the 20th Century, removed approximately 500,000 ounces of gold (Strachan 2005). Mining companies continue to explore for gold in the drainage and have conducted an extensive drilling program to define the lode bearing ore bodies. They have also expressed an interest in reworking the old dredge tailings.

Project Objectives

Project objectives for 2014 were to: (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. These data support the in-season and post-season management of the Kuskokwim River subsistence and commercial fisheries. This information also assists managers in establishing and evaluating escapement goals to maintain the sustainability of salmon stocks returning to the Tuluksak River.

Methods

Weir and Video Operations

A resistance board weir (Tobin 1994) affixed with an underwater video system (Gates et al. 2010; Miller and Harper 2014) was installed during 2014 in the Tuluksak River at rkm 49 (N 61°02.641', W160°35.049'). This location is approximately 16 rkm downstream from the weir site used by the Service from 1991 to 1994 (Harper 1995a, 1995b, 1995c, 1997). The lower site provides easier boat access during low water conditions and is downstream of known salmon spawning (Figure 1).

Setup and design of the video system was similar to that used in previous years (Miller and Harper 2014). One underwater video camera was located inside a sealed video box attached to the fish passage chute. The video box was constructed of 3.2-mm aluminum sheeting and was filled with filtered water. Safety glass was installed on the front of the video box for a scratch-free, clear surface through which images were captured. The passage chute was constructed from aluminum angle and was enclosed in plywood isolating it from exterior light. The backdrop of the passage chute from which video images were captured could be adjusted laterally to minimize the number of fish passing through the chute at any one time. The backdrop could also be easily removed from the video chute when dirty and replaced with a new one. All video images were recorded on a removable 1,000 gigabyte hard drive at 30 frames per second using a computer-based digital video recorder (DVR). Stored video files were reviewed daily. The video box and fish passage chute were artificially lit using a pair of 12-V DC underwater pond lights. Pond lights were equipped with 10-W bulbs which provided a quality image. The lights provided a consistent source of lighting during day and night hours. The DVR was equipped with motion detection to minimize the amount of blank video footage and review time.

During 2014, one passage panel and live trap was installed and affixed with an underwater video system. The video system and weir were operated in unison during 2014 and the video system recorded fish passage 24 hours each day. Visual counts from live video or counts from motion detection data files were recorded during each shift. Video footage collected between 0000 hours and 0700 hours was reviewed and counts added to hourly passage for that day. Paired counts using continuous video feed and motion detection footage were performed daily for a one hour block to validate visual counts. If problems with the video equipment occurred, live counts

through the passage chute were taken until issues could be resolved. Sex composition was determined from two independent observations using video footage similar to 2011-2014 (Miller and Harper 2014). An object was passed in front of the video camera periodically to confirm the video system's motion detection was operating correctly. Migrating and resident fish were identified to species and recorded.

The daily average depth of the river at the weir site was estimated using fixed staff-gauge measurements from June 26 to September 11. Staff-gauge measurements were converted to average depth of the river at the weir site for comparison between and amongst years. The average depth of the river at the weir site was defined as:

$$average\ water\ depth = \frac{S_t}{\left({S_y}/{\mu_y}\right)}$$

Where: S_t is the observed staff gauge height at time t, S_y is the observed staff gauge height while measuring the benchmark mean depth during year y, μ_y is the mean depth during year y. The benchmark mean depth at the weir for each year was calculated from measurements made every 2−3 m spanning the river. Ambient temperature, water temperature, and fish passage counts were relayed daily by cell phone or email to Service staff in Bethel who in turn updated the Department via email daily. Hobo® recording thermometers were installed at the weir to collect water and ambient temperature data for a separate study addressing climate change funded by the Office of Subsistence Management, Fisheries Resource Monitoring Program (OSM-FRMP) project 08-701.

Biological Data

Biological data on fish age, sex, and length (ASL) was collected using a temporally stratified sampling design (Cochran 1977), with statistical weeks defining strata. A sample of fish was drawn weekly for ASL information from the live trap. Adult salmon were captured using the live trap attached to the passage chute. Sampling started when approximately 40 fish were in the trap. To the extent logistically feasible, a sample was collected over the shortest possible period and on days when sampling occurred, samples were taken periodically throughout the day. To avoid potential bias caused by the selection or capture of individual fish, all fish within the trap were included in the sample, even if the target number of fish was exceeded. If the sample quota for a given species was attained the trap was closed to sample other species and those fish were netted and released upstream of the weir and the desired species sampled.

Sample size goals for Chum, Chinook and Coho salmon for each stratum (Table 1) were adopted from Bromaghin (1993) using simultaneous 95% confidence intervals with $\alpha = 0.05$ and $d = 0.10$, and an expected unreadable rate of 20%. Sampling for Sockeye Salmon was opportunistic, with a target sample of 75 fish for the season. However, if not enough fish passed the weir during a stratum to meet the sample goal as many fish as possible were sampled each day of that stratum.

TABLE 1.— Stratum sample size goals.

Salmon Species	Age Classes	Sample size
Chum	0.3, 0.4	188
Chinook	1.2, 1.3, 1.4, 1.5	225
Coho	2.1, other	188

Sampling (ASL) consisted of measuring length from the mid-eye to fork in the caudal fin (MEF), determining gender, collecting scales, examining fish for gill-net marks, and then releasing the fish upstream of the weir. Salmon were measured from mid-eye to fork-of-caudal fin to the nearest millimeter. Gender was determined by observing external sex characteristics including the presence or advanced development an ovipositor.

Scales were removed from the preferred area for age determination (Koo 1962; Mosher 1968). Scales were collected and checked visually to the best extent possible to make sure they were not damaged, regenerated or from the lateral line. One scale was collected from each Chum, three from each Sockeye, and four scales from each Chinook and Coho salmon. If a scale from the preferred area was missing, damaged, or regenerated, a scale from the same area on the opposite side of the fish was selected. If scales were absent in the preferred area on either side of the fish a scale as close to the preferred area as possible was selected and a note "non-preferred scale" was entered on the ASL field form.

Video footage was also used to determine the gender of passing salmon. Females were identified as having blunt-shaped heads, and a round-shaped abdomen, whereas males generally exhibit a prolonged head accompanied with a kype, a gradual dorsal hump, and a thinner abdomen. The number of fish viewed from the video followed the same strategy used for that of fish collected from the live trap. Once the weekly ASL sample size was met for a species, sampling would stop for that species. Although biological sampling was stratified into statistical weeks a priori, strata for the analysis of Pacific salmon biological data at the Tuluksak River weir were modified following the field season to represent actual weir passage and ASL sample sizes.

Data were recorded and later transferred to digital spreadsheets. Service staff aged the scales and processed the forms. Counts and ASL data were shared with the Department in Anchorage. Salmon ages 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 is determined by adding one year to the sum of the two digits on either side of the decimal; i.e., age 1.4 and 2.3 are both 6-year-old fish from the same brood year (1.4 = 1 + 4 + 1 = 6, and 2.3 = 2 +3 + 1 = 6). The brood year is determined by subtracting fish age from the current year.

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 in 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 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 in 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 rth 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

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

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):

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

Estimates were calculated for dates with partial and zero counts due to flooding or holes in the weir. Estimates were based on the average daily proportion of passage from previous years. An average of the daily proportions for previous years was calculated because daily escapement can vary between years. The sum of the averaged daily proportions, calculated for days with partial or zero counts, is the estimated total proportion of the missed escapement. The total escapement is the sum of the observed counts divided by one minus the proportion missed. Averages in the historical escapement figure were generated using prior years with escapement estimates (Gates and Harper 2002; Zabkar and Harper 2004, 2005; Zabkar et al. 2006; Plumb et al. 2007; Plumb and Harper 2008; Miller and Harper 2009-2014).

Results

Weir and Video Operations

The crew traveled to the weir site by boat on June 26, 2014. Installation of the weir and video system were completed on June 29, and both were operational through September 12. The water stage depth ranged from 66 to 159 cm during 2014. The recorded minimum water stage height occurred July 5, and the maximum stage height depth on August 8 (Appendix 1). Water temperatures (daily average) ranged from 7.5°C on September 5 to 14°C on July 5. Ambient temperatures (daily average) ranged from 3°C on August 30 to 19°C on July 30 (Appendix 1).

Biological Data

Chum Salmon —A total of 8,726 Chum Salmon were counted through the weir from June 30 to September 12 (Table 3; Figure 2; Appendix 2). The peak weekly passage of 2,386 Chum Salmon occurred July 19–26 (Figure 2) and median cumulative passage occurred on July 21 (Figure 3; Appendix 2). The first Chum Salmon passed through the weir June 30 and the last on September 11 (Appendix 2).

Age, sex and length were collected from 1,192 Chum Salmon scale samples of which 1,113 (93%) were readable (Table 2). Four ages (0.2, 0.3, 0.4, and 0.5) of Chum Salmon were identified from scale samples. The predominant age was 0.3 for both male (64%) and female (73%) Chum Salmon (Appendix 3). Ages 0.3 and 0.4 comprised 95% of the total Chum Salmon escapement. Females comprised 41% of the ASL collection and 43% of the video footage (n = 3,925; Table 2) and were more predominant as the run progressed (Figure 3; Appendix 3). The mean MEF length of males was larger than females for all ages (Appendix 4).

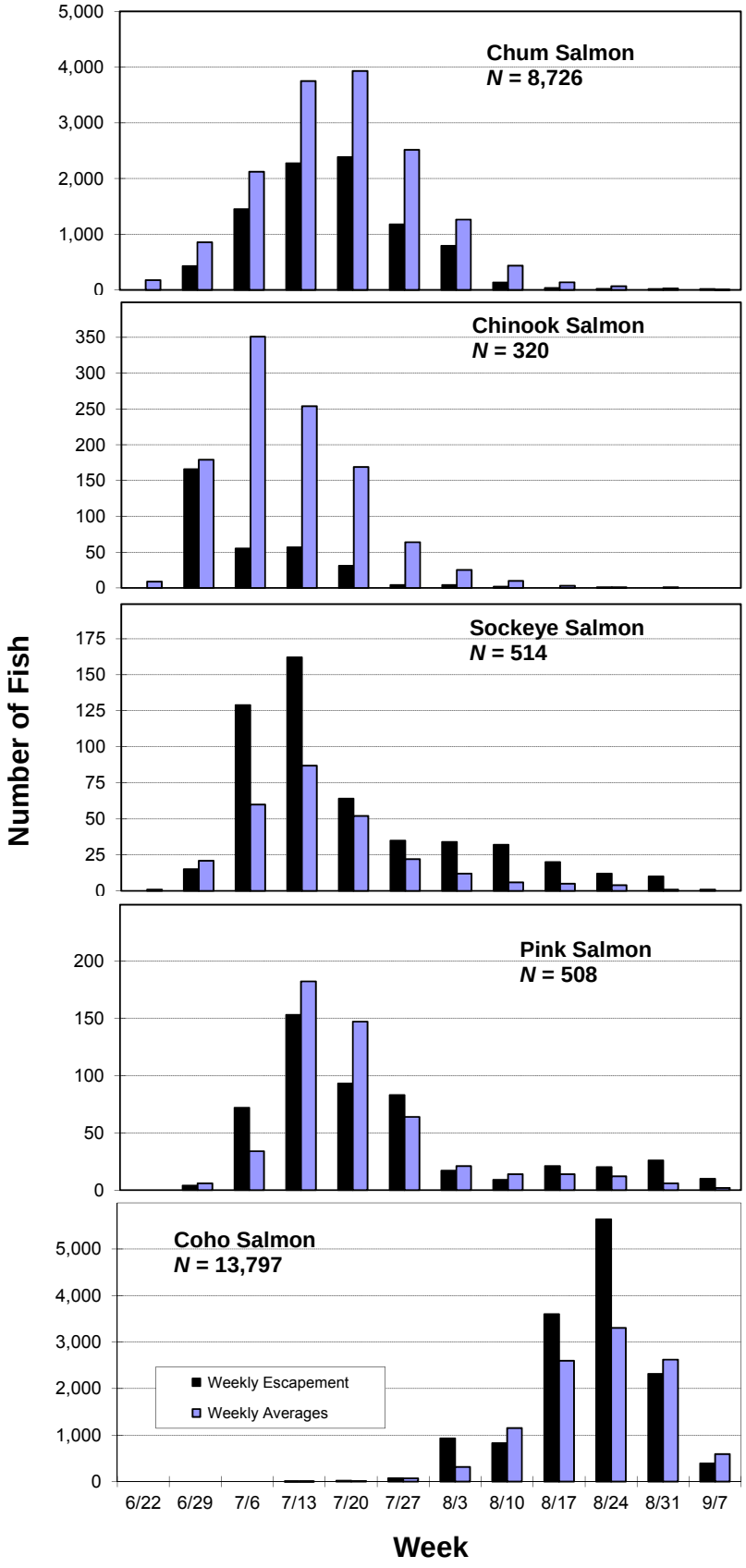

FIGURE 2.—Weekly escapement of Chum, Chinook, Sockeye, Pink and Coho salmon passing through the Tuluksak River weir, 2014. Average weekly totals for Chum, Chinook, Sockeye, and Coho salmon are for years 1991−1994, 2001−2013 and for Pink Salmon even years 2002−2012.

Table 2.—Escapement and sample size totals for ASL from scales and video footage.

		Age, Sex and Length Collections		
		Scales		Video
Salmon Species	Escapement Total	Sample Total	Readable Total	Viewed Total
Chum	8,726	1,192	1,113	3,925
Chinook	320	60	52	232
Sockeye	514	90	87	253
Pink	508	0	0	225
Coho	13,797	687	609	13,011

Chinook Salmon —A total of 320 Chinook Salmon were counted through the weir from June 30 to September 12 (Table 3; Figure 2; Appendix 2). The first Chinook Salmon passed through the weir June 30 and the last August 28. The peak weekly passage of 166 Chinook Salmon occurred June 20 to July 5 (Figure 2) and the median cumulative passage occurred on July 5 (Figure 3; Appendix 2).

Age, sex and length were collected from 60 Chinook Salmon scale samples of which 52 (87%) were readable (Table 2). The scale collection represents 19% of the total Chinook Salmon counted past the weir. Six ages (1.2, 1.3, 2.2, 1.4, 2.3 and 1.5) of Chinook Salmon were identified from scale samples. The predominant age was 1.3 for male (58%) and 1.4 for female (64%) Chinook Salmon (Appendix 5). Ages 1.3 and 1.4 comprised 67% of the total Chinook Salmon escapement. Females comprised 27% of the ASL collection and 36% of the observed video footage (n = 232; Table 2) and were more predominant as the run progressed (Figure 3; Appendix 5). The mean MEF length of males was larger than females for age-1.3 (Appendix 6).

Sockeye Salmon —A total of 514 Sockeye Salmon were counted through the weir June 30 to September 12 (Table 2; Figure 2; Appendix 2). The first Sockeye Salmon passed the weir July 1 and the last September 8. The peak weekly passage of 162 Sockeye Salmon occurred July 13–19 (Figure 2), and the median cumulative passage occurred on July 16 (Appendix 2).

Age, sex and length were collected from Sockeye Salmon scale samples of which 87 (97%) were readable (Table 2). The scale collection represents 18% of the total Sockeye Salmon counted past the weir. Seven ages (0.2, 0.3, 1.2, 1.3, 2.2, 1.4 and 2.3) of Sockeye Salmon were identified from scale samples. The predominant age was 1.3 for both male (53%) and female (67%) Sockeye Salmon (Appendix 7). Ages 1.2 and 1.3 comprised 75% of the total Sockeye Salmon escapement. Females comprised 48% of the ASL collection and 42% of the Observed video footage (n = 253; Table 2) (Figure 3; Appendix 7). Sockeye Salmon MEF lengths ranged from 465 to 660 mm in the ASL collection and the MEF length of males was larger than females for all ages except age-0.2 (Appendix 8).

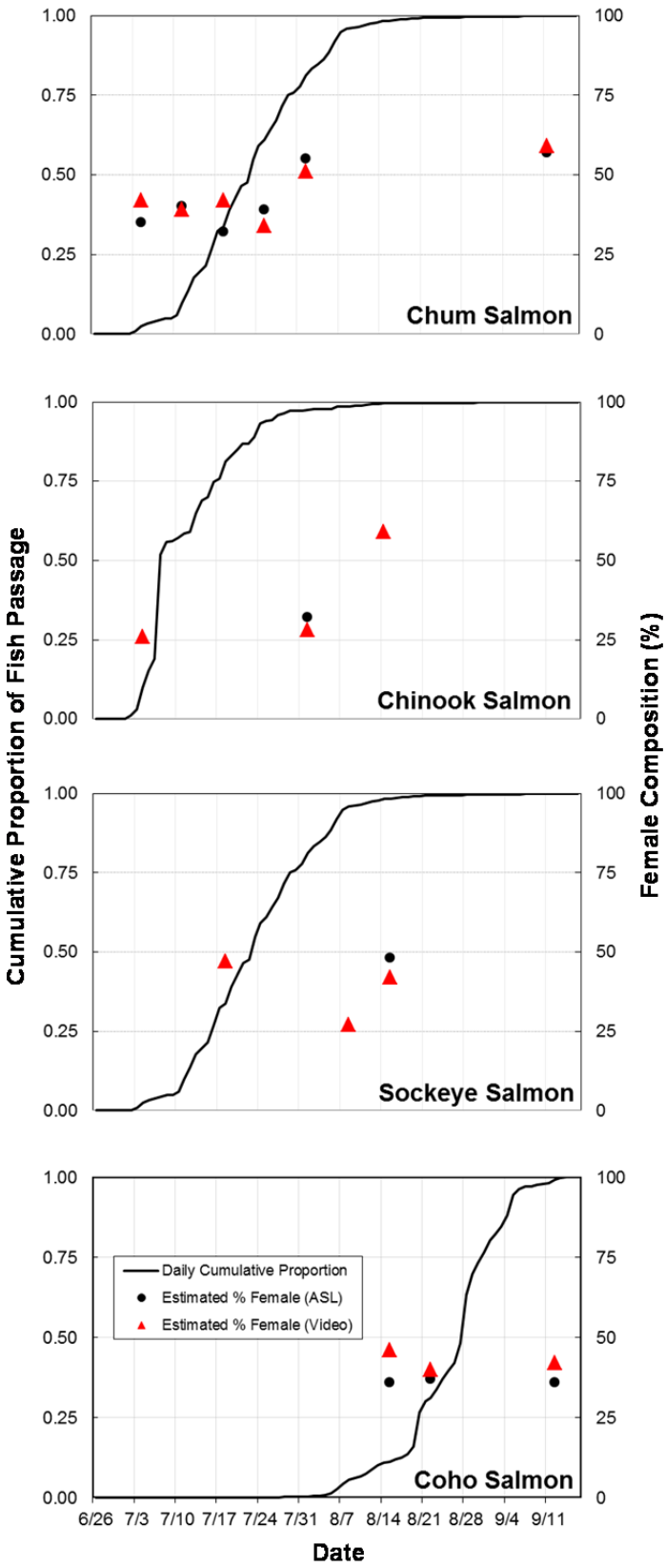

FIGURE 3.— Cumulative proportion, and estimated percent of females–from ASL samples and video–for Chum, Chinook, Sockeye and Coho salmon passed through the Tuluksak River weir, 2014. Estimates of female percent passage are represented by symbols at the midpoint of each categorical stratum. The first strata (June 22 to 28) is a partial strata with counts beginning on June 25th. Strata with low ASL sample sizes were combined.

Pink Salmon —A total of 508 Pink Salmon were counted through the weir June 30 to September 12 (Table 2; Figure 2; Appendix 2). The first Pink Salmon passed through the weir July 1 and the last September 12. The peak weekly passage of 153 Pink Salmon occurred July 13−19 (Figure 2) and the median cumulative passage occurred on July 21 (Appendix 2). Age, sex, and length data were not collected from scales for Pink Salmon, however, 24% were classified as females from video samples (n = 225; Table 3).

Coho Salmon —A total of 13,797 Coho Salmon were counted through the weir from June 30 to September 12 (Figure 2; Appendix 2). The first Coho Salmon passed through the weir July 17 and 26 were counted on the last day of operations, September 12. The peak weekly passage of 5,640 Coho Salmon occurred August 24–30 (Figure 2), and the median cumulative passage occurred on August 26 (Appendix 2).

Age, sex and length were collected from 687 Coho Salmon scale samples of which 609 (89%) were readable (Table 2). The scale collection represents 5% of the total Coho Salmon counted past the weir. Three ages (1.1, 2.1 and 3.1) of Coho Salmon were identified from scale samples. The predominant age was 2.1 for both male (72%) and female (76%) Coho Salmon (Appendix 9). Age-2.1 comprised 73% of the total Coho Salmon escapement. Females comprised 37% of the ASL collection and 42% of the video footage (n = 13,011; Table 2) (Figure 3; Appendix 9). The mean MEF length of females was larger than males for all ages except age-3.1 (Appendix 10).

Other —Resident and other migrant species counted through the weir in 2014 consisted of 36 Dolly Varden *Salvelinus malma*, 17 Northern Pike *Esox lucius*, 9 Arctic Grayling *Thymallus arcticus,* 23 Humpback Whitefish *Coregonus pidschian*, 13 Broad Whitefish *C.nasus,* and 27 Round Whitefish *Prosopium cylindraceum*. Smaller fish (≤40 cm) were likely able to pass through the pickets, and only fish observed through the passage chute were recorded.

Discussion

Weir and Video Operations

The weir is typically installed the third week of June and is operational through September 10 (Miller and Harper 2014). During 2014, the lack of a partnership with the TNC and the inability to hire an adequate number of trained staff to operate the weir in a timely manner led to delays and the weir was not fully operational until June 30. The average cumulative proportion of fish passage prior to June 30 for Chinook Salmon has been less than 2% and for all other species less than 1% (Miller and Harper 2014), so few fish went uncounted. High water later during the season limited sample collections because of safety concerns (Appendix 1). General maintenance became problematic late in the season due to high water with debris removal, continual picket repair, and broken bolts on resistance boards.

The underwater video system proved effective in the enumeration of Chum, Chinook, Sockeye, and Coho salmon during most flow conditions. Data collected from video footage were useful for counts, speciation, sex composition, and comparing sex composition across strata with the ASL sample collection (e.g., Figure 3; Appendices 3 and 11). The video system proved very useful for identification and counts of other species passing the weir. Between 2001 and 2009, coregonids were enumerated and classified as 'whitefish' and counts ranged from 3 to 94 fish (Miller and Harper 2014). Since 2010, the addition of video has allowed us to enumerate and identify three distinct whitefish species (Miller and Harper 2014).

To conserve Kuskokwim River Chinook Salmon stocks, restrictions were implemented by managers during 2014 (Table 3). These actions led to local opposition of the Kwethluk and Tuluksak River weirs during 2014. The Service had partnered with the TNC during 1991−1994 and 2001−2013, and the majority of crew members associated with the Tuluksak River weir were tribal members hired by TNC.

During 2014 two different documents were presented to the Service stating opposition to the Chinook Salmon harvest restrictions. A Joint Group Resolution Number:14-01 (Anonymous, 2014a) was presented by the Kwethluk Joint Group to the Office Subsistence Management (OSM) at the Yukon-Kuskokwim Delta Subsistence Regional Advisory Council meeting held in Bethel during April 2014. This resolution listed several 'conditions' as the result of Federal and State managers implementing restrictions on Chinook Salmon harvest during 2014. The resolution specifically stated, 'The Kwethluk IRA Council will retract its Kwethluk River Weir agreement'. Also, a collective statement signed by the federally recognized tribes of Akiachak Native Community, Akiak Native Community, Organized Village of Kwethluk, and Tuluksak Native Community was submitted to the Service in May 2014 addressing Chinook Salmon harvest restrictions (Anonymous, 2014b). In that statement, section 4 states, 'The Tribes shall nullify any Fish Weir Agreements with the USFWS, including Science camps located at Kwethluk and Tuluksak Rivers'. TheService and the Councils were unable to resolve differences over the following weeks.

Managers decided to move forward with these monitoring projects, despite grievances voiced by local residents, and collect the data considered necessary to manage the fishery and conserve Chinook Salmon. The Kwethluk River weir is one of only two projects monitoring the escapement of salmonids on Federal lands within the lower Kuskokwim River drainage. The uncertainty in establishing a partnership led to a delay in the hiring of crew members and weir operations.

During the winter of 2013 the Alaska Board of Fisheries established a drainage-wide Chinook Salmon SEG of 65,000−120,000 fish based on ADF&G escapement goal recommendations (Conitz et al. 2012). The 2014 Kuskokwim River Chinook Salmon pre-season forecast estimate was 71,000−117,000 fish (ADF&G 2014). Based on this forecast, the SEG of 65,000−120,000 fish, and an average subsistence harvest of 84,000 fish, a decision was made by managers to restrict fishing for Chinook Salmon at the start of the season and use abundance indices at the Bethel Test Fishery to inform management decisions. The Federal Subsistence Board also adopted a Special Action request submitted by the village of Napaskiak to close the Kuskokwim Chinook Salmon fishery to non-Federally qualified users. The State Board of Fisheries approved dip nets as a method to allow subsistence opportunity during times of Chinook Salmon conservation. Once Chum and Sockeye abundance exceeded Chinook salmon abundance, restrictions on subsistence opportunity for Chinook Salmon were relaxed starting June 20. The use of 6-inch mesh gillnets for open periods (June 20) and fish wheels fitted with a 'live box' to facilitate the release of Chinook Salmon (June 19) were implemented. However, based on conservation concerns for tributary stocks, gear restrictions remained in effect for the Kwethluk, Kisaralik, Tuluksak, and Aniak rivers, and in specific sections of the Kuskokuak and Old Kuskokuak sloughs, similar to 2011-2013 (Table 3).

Biological Data

Chum Salmon —The 2014 Chum Salmon count of 8,726 was near the lower end of the historical range of 7,675–35,696 fish (Figure 4) and below a 17-year average of 15,216 Chum Salmon (Miller and Harper 2014). The 2014 Chum Salmon escapement was 24% of the 2005 record high escapement of 35,696. The median passage date for Chum Salmon occurred on July 21,

which was similar to 1991, 1992, 1994, 2007 and 2008, and 4 days later than the earliest recorded during 2002 (Figure 5, Appendix 9). The cumulative Chum Salmon passage of 99% occurred on August 17, which is the same date as the average cumulative proportion since 2001 (Appendix 2; Miller and Harper 2014).

Females comprised an estimated 41% of the total Chum Salmon escapement (Appendices 3 and 11). Video and ASL collections were compared for stratum 2−12 (Appendix 3). The difference in sex composition between the ASL samples and the video during June 30 and September 13 may be the result of sample timing and sample size. Video and ASL data varied within strata but gender proportions were similar across the strata (Figure 3; Appendix 3). The weekly composition of female Chum Salmon gradually increased from less than 50% to greater than 50% as the season progressed (Appendix 3).

The dominant ages during 2014 for Chum Salmon were ages 0.3 (68%) and 0.4 (27%), (Appendix 3). Age-0.3 increased from 40% during 2013 to 68% during 2014 and age-0.4 Chum Salmon decreased from the 59% during 2013 to 27% during 2014 (Appendix 3; Miller and Harper 2014). The number of readable scales (n = 1,113) was 93% of the total sample (n = 1,192) and considerably greater than the average percentage (85%) of readable scales.

Chinook Salmon —The Chinook Salmon count of 320 during 2014 was the third lowest on record and well below the 17-year average of 1,048 and the median of 737 Chinook Salmon for the ninth consecutive year (1991–1994 and 2001–2013; Figure 4). However, this year's escapement was 127 fish higher than the previous year's lowest escapement of 193 fish and higher than 3 of the previous 4 years (2010 to 2013). During 2014, harvest was restricted similar to 2012 whereas it was unrestricted during 2013 (Miller and Harper 2014). Harvest restrictions in 2014 may have had a direct impact on the increased number of Chinook Salmon passing the Tuluksak River weir (Figure 4).

Median passage dates for Chinook Salmon have fluctuated from July 5 to July 22 during previous years (Figure 5). The median passage date for 2014 was July 5, similar to 2003 the previous earliest median passage date (Miller and Harper 2014) (Figure 5, Appendix 11). Reasons for these shifts in run timing are not well understood, but possible factors may include changes in climate and oceanographic conditions, change in management strategies that perhaps directed harvest pressures on different portions of the run, prevailing winds, or both, and river flows at the time of the runs. Greater than 99% of the average cumulative passage for Chinook Salmon from 1991 to 1994 and 2001−2013 occurred by August 12, three days later than during 2014 (Miller and Harper 2014).

During 2014, female Chinook Salmon comprised 27% of the ASL and 36% of the video footage collections and was within the historical range of 14−48% (Miller and Harper 2014). Age, sex and length data collected were from an ASL sample (n = 60) between July 7 and July 31 and video footage samples from June 30 to August 12. Gender composition from the ASL samples represented 19% of the total Chinook Salmon that passed through the Tuluksak River weir during 2014. However, gender composition from video footage with a sample size of n = 232 fish represents 73% of the Chinook Salmon escapement.

Table 3.—Special actions and emergency orders enacted during 2014 in the Kuskokwim River drainage.

Release Date	Special Action/Emergency Order / News Release
3/28	ADFG New Release; Revised 2014 Kuskokwim River Salmon Fishery News Release 1; Alaska Board of Fisheries Decisions on Kuskokwim River Emergency Petitions. Petition to add dip nets as legal gear and provide ADFG the ability to restrict the length of subsistence gillnets.
5/1	ADFG Emergency Order 3-KS-01-14; Order closes all waters of the Kuskokwim-Goodnews area to sport fishing for king salmon and gear restriction. 5/1 Until Further Notice (UFN).
5/6	FSB, 2014 Kuskokwim area salmon fishery News Release, 2014 Kuskokwim area outlook and pre-season Management strategy.
5/16	FSB News Release #2; Corrected Federal Waters within the boundaries of the Yukon Delta NWR. Two special actions were issued restrictions to the Chinook fishery that will begin on 5/2; 1) 3-KS-01-14 limits who can and can't fish for Chinook, residents and members of the certain villages; 2) 3-KS-02-14 closes Chinook salmon fishery in the Kuskokwim to all user groups and limits gillnet use and gear .
5/16	FSB Special Action # 3-KS-02-14. Special action closes Chinook salmon fishing to all user groups in conservation sections 1 and 2 on Kuskokwim River drainage, effective 5/20-7/14. Also gear restrictions implemented.
5/16	FSB Special Action # #-KS-01-14. Federal public waters of the Kuskokwim River drainage will be closed to fishing for king salmon to non-Federally qualified users to provide for escapement 5/20 - 7/18. Biological justification included.
5/21	ADFG 2014 Kuskokwim River Salmon Fishery News Release #2, Emergency order #3-S-WR-01-14. Management of the king salmon fishery from the mouth of the Kuskokwim River to the confluence of the Aniak and Kuskokwim rivers (defined as the Federal Conservation Unit) is under
5/23	FSB, 2014 Kuskokwim Area Salmon Fishery News Release #3. Special action issued restricting Chinook fishery beginning 5/27, Biological Rationale and affected area, effective 5/27-UFN.
5/23	FSB, Special Action 3-KSW-03-14. Special Action closes king salmon fishing to all users in the conservation section 3 from Tuluksak to the boundary of the Yukon Delta NWR near Aniak. Effective dates 5/27-7/18.
5/31	ADFG Emergency Orders #3-S-WR-03; 3-S-WB-01-14; 3-S- WB-02-14; ADFG will be managing Kuskokwim Area salmon fisheries to conserve Chinook salmon in 2014. Kuskokwim River to Naskonat Peninsula 6/1 - UNF, Distric W-4, Quinhagak closures 6/8, 6/15, 6/22 and 6/29; District W-5, Goodnews Bay gillnet restrictions 6/2 - UFN.
6/3	ADFG News Release 2014 Kuskokwim River salmon fishery announcement #4; Marine waters near the Kuskokwim River mouth, closed to subsistence fishing from 6/-UFN; Coastal waters from Ishkowik River to Naskonat Peninsula gillnet restriction 6/3 - UFN; Yukon Delta NWR boundary at Anaik to the Holitna River mouth, closed to subsistence fishing for salmon and subsistence fishing for non salmon species with gillnets is restricted to gillnets with 4-inch or less mesh size not exceeding 60 feet in length and 45 meshes in depth; Holitna River mouth to the headwaters of the Kuskokwim River: section 5, Subsistence fishing for salmon scheduled to close 6/4.
6/9	ADFG News Release, Kuskokwim River Salmon Fishery Announcement #5, Emergency order #3-s-WR-03-14, From the Yukon Delta NWR boundary to Aniak to the Headwaters of the Kuskokwim River 6/10-UFN subsistence fishing for king salmon with hook and line closure.
6/10	FSB News Release #4; Federal Special Action issued implementinga special allocation, permit-only salmon fishing with gillnets of up to 6" mesh, 50 fathoms in length, 45 meshes in depth, Mondays, Wednesdays and Fridays from 6/11-6/30 for those Kuskokwim communities which have received Social and Cultural harvest permits from the USFWS.
6/10	FSB Special Action # 3-KS-04-14; Kuskokwim River and all Kuskokwim River Tributaries within the NWR boundaries. Opens salmon fishing with gillnets with no more than 6"mesh, 50 fathoms long, 45 meshes deep only for those communities which have been issued Social and Cultural Harvest permits.
6/10	FSB, 2014 Kuskokwim Area Salmon Fishery News Release #4, Federal waters within the NWR boundaries, Federal Special action implementing permit-only salmon fishing, etc. Was developed in response to requests and formal proposals as discussed with tribal members, Kuskokwim River Salmon Management Working Group, and the Yukon Kuskokwim Regional Advisory Council, 2014.
6/13	ADFG News Release Kuskokwim River salmon fishery announcement #6 Emergency order #3-S-WR-05-14, Kuskokwim River Subsistence fishing opportunity for sockeye and chum salmon. Mouth of the Kuskokwim River to Tuluksak: Subsistence fishing with dip nets allowed for 12 hours daily from 9:00 a.m to 9:00 p.m. 6/15-6/30, no retention of king salmon. Tuluksak to the Yukon Delta NWR boundary at Aniak; subsistence fishing with dip nets allowed for 12 hours daily 6/17-6/30, no king salmon retention.
6/16	ADFG News Release; Kuskokwim River Salmon Fishery Update #1 - Kuskokwim River Inseason Assessment and Run Status.
6/20	FSB Special Action 3-KS-05-14; opened fishing with gillnets (set or drift) 6" mesh or less, 50 fathoms long, 45 mesh deep , downriver of the Johnson River; 4 pm to 8 pm 6/20/14.
6/20	ADFG Emergency Order #3-S-WR-07-14; Subsistence fishing for chum and sockeye with gillnets 6"mesh or less, 50 fathoms in length, 45 mesh deep from 4 pm until 8 pm 6/20/14 from Johnson River to the lower boundary of Subdistrict 1-B (southern tip of Eek Island).
6/20	ADFG Emergency Order #3-S-WR-07-14; Subsistence fishing for chum and sockeye with gillnets 6"mesh or less, 50 fathoms in length, 45 mesh deep from 4 pm until 8 pm 6/20/14.
6/20	ADFG Emergency Order #3-S-WR-07-14; Subsistence fishing for chum and sockeye with gillnets 6"mesh or less, 50 fathoms in length, 45 mesh deep from 6/20 until further notice (UFN) from the lower boundary of Subdistrict 1-B and Marine waters near the Kuskokwim River mouth.
6/22	FSB Special Action 3-KS-07-14; transition period from Chinook to a chum and sockeye fishery and from Federal to State management, 6/22 - 7/14.
6/22	FSB Special Action 3-KS-06-14; opened fishing with gillnets (set or drift) 6" mesh or less, 50 fathoms long, 45 mesh deep, downriver of a line drawn from Apokak Slough to the Southernmost tip of Eek Island to Popokamiut, 6/22 - 7/14.
7/22	ADFG News Release, Kuskokwim River salmon fishery announcement #18 Commercial fishing suspended

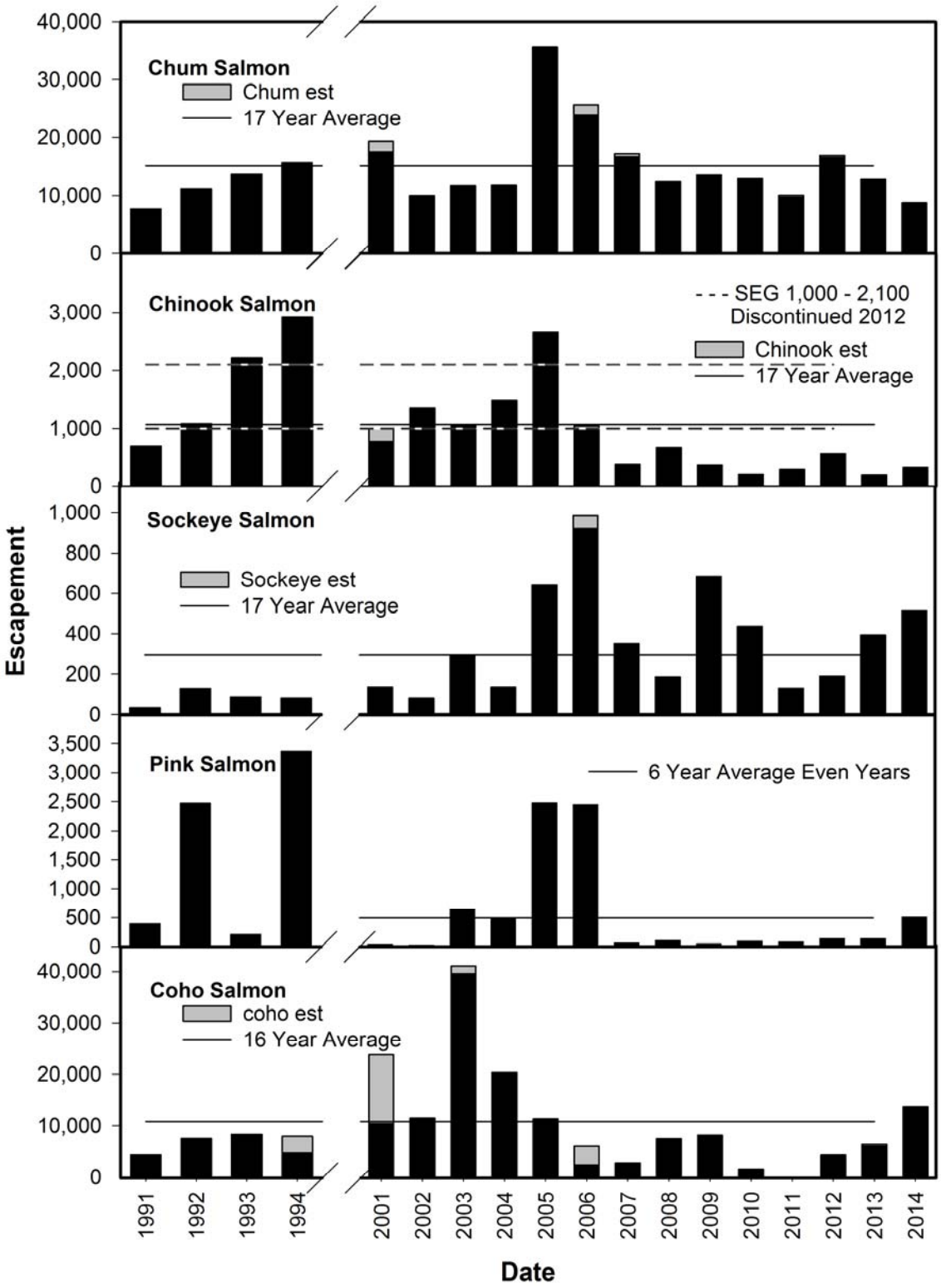

FIGURE 4.—Salmon escapement estimates through the Tuluksak River weir; 1991–1994 and 2001–2014. Averages include estimates for days missed. Pink Salmon averages are for years after 2000 when wider picket spacing was used on weir panels. Total escapements for Coho Salmon were not estimated during 2010 and 2011 (Miller and Harper 2012) due to incomplete counts. Note: Y-axis ranges are different for all species. No estimates were made for Coho salmon escapements during 2011.

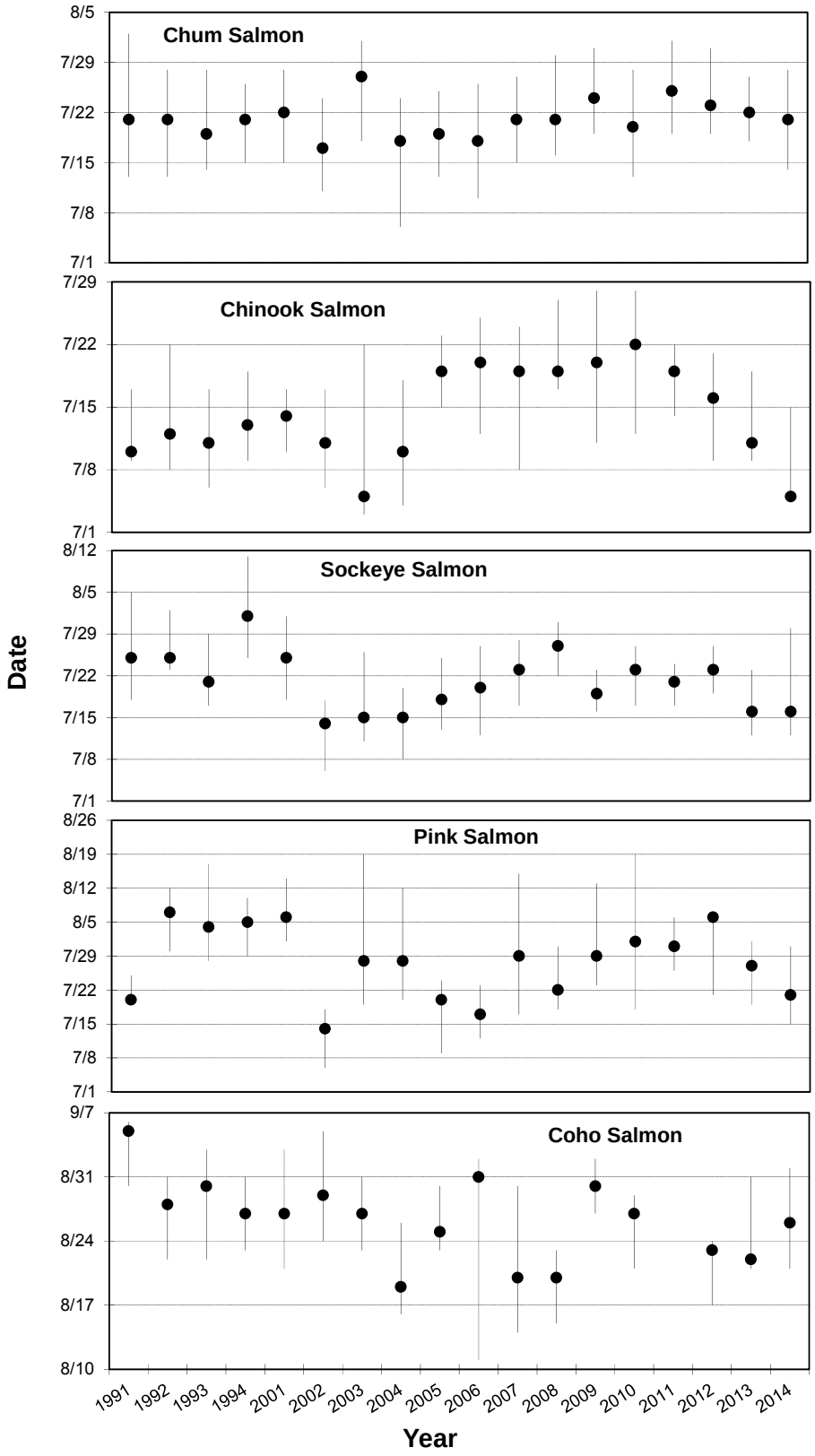

FIGURE 5.—Median cumulative passage for Chum, Chinook, Sockeye, Pink, and Coho salmon at the Tuluksak River weir; 1991–1994 and 2001–2014. A median date was not estimated for Coho Salmon during 2011. The filled circles represent the median (50%) passage date and the vertical line below and above the circle represent the second and third quartiles, respectively. Note date differences on Y axis.

During 2014, female Chinook Salmon comprised 27% of the ASL and 36% of the video footage collections and was within the historical range of 14−48% (Miller and Harper 2014). Age, sex and length data collected were from an ASL sample (n = 60) between July 7 and July 31 and video footage samples from June 30 to August 12. Gender composition from the ASL samples represented 19% of the total Chinook Salmon that passed through the Tuluksak River weir during 2014. However, gender composition from video footage with a sample size of n = 232 fish represents 73% of the Chinook Salmon escapement.

The 2014 ASL collection of readable scales (n = 52) was small, primarily due to the low abundance of Chinook Salmon and their passage patterns through the weir. During 2014, Chinook Salmon passage only exceeded 20 fish per day on two occasions. Passage of Chinook Salmon was sporadic during 2014 and 33% of the return passed in one day (July 5). Most of the Chinook Salmon passed between midnight and 0400 hours. Sampling strategy may need to be revised to reflect the pattern of low returns and fish passage at night. Currently fish gender, length, and length-at-age using morphology measurements (Clary 2006, 2007) from video footage are being explored at the Kwethluk River weir and may be useful in addressing low returns and a need to collect ASL samples (Miller and Harper 2014).

Given the trend of low escapement for Chinook Salmon and the likely low number of females estimated during 2014, it is unknown how much this brood year will contribute to future runs of Chinook Salmon to the Tuluksak River. The poor runs since 2007 indicate the Chinook Salmon population in the Tuluksak River is depressed. For comparison, from 2007 to present Chum Salmon runs have remained fairly stable while Sockeye and Coho salmon runs have increased.

Sockeye Salmon —The Sockeye Salmon count of 514 during 2014 was the fourth highest on record and above the 17-year average of 287 Sockeye Salmon (Figure 4). Estimated escapements for Sockeye Salmon range from 34 fish in 1991 to 985 fish in 2006. Median passage dates for Sockeye Salmon have fluctuated since 1991 between July 14 and August 1, a difference of 19 days (Figure 5; Appendix 11). The median passage date during 2014 was the same as in 2013 (July 16) and similar to 2003 and 2004 (Appendix 11). The average cumulative passage date of 99% for Sockeye Salmon since 2001 is September 2 (Miller and Harper 2014), 1 day earlier than 2014 (Appendix 2).

During 2014, female Sockeye Salmon comprised 48% of the escapement, which was similar to 2009 and 2003. The ASL samples and the video sample collections represented 17% and 49% of the total Sockeye Salmon escapement, respectively, and is considered adequate to accurately characterize the age, sex, and length-at-age for the Sockeye Salmon escapement.

Pink Salmon —The 508 Pink Salmon observed passing through the weir during 2014 was the fourth highest since 2001 and between the odd-year average (2001−2013) of 529 and the even-year average (2002−2012) of 504 fish (Figure 4). The median cumulative passage date of July 22, based on the Pink Salmon count, was the fifth earliest recorded (Figure 5; Appendix 11). Age, sex, and length data were not collected for Pink Salmon. However, from video footage a total of 225 Pink Salmon were viewed and 24% were classified as female. Pink Salmon returns to the Tuluksak River have been low since 2007.

Coho Salmon —The 2014 Coho Salmon count of 13,797 was within the historical range of 1,216–41,071 fish and above the estimated 15-year average of 10,839 (Figure 4). This was the fourth highest escapement and the highest recorded since 2004 (Miller and Harper 2014).

The median passage date for Coho Salmon occurred on August 26. (Figure 5; Appendix 11). The 2014 estimate of 99% passage on September 10 was 2 days earlier than the average cumulative passage date (1991–1994 and 2001–2010, 2012, 2013) of September 12. Female Coho Salmon comprised 37% of the ASL collection which was the fourth lowest recorded and within the historical range of 31% (2009) to 58% (2002) (Appendix 11). The sex composition of Coho Salmon using ASL samples (n = 608) compared to video footage (n = 13,011) differed by 5% (Appendix 9). The historical Coho Salmon escapement has varied in number, timing, and percent females since the project began in 1991 (Figure 4; Appendix 11; Miller and Harper 2014).

Recommendations

The Tuluksak weir and other escapement projects throughout the Kuskokwim River drainage provide important information for Service and Department fishery managers; therefore, it is recommended that the operation of the Tuluksak River continue during 2015. Specific objectives and a study design should be developed to test the hypothesis that length measurements and morphological features derived from video images can successfully describe the length and sex composition of returning adult salmon.

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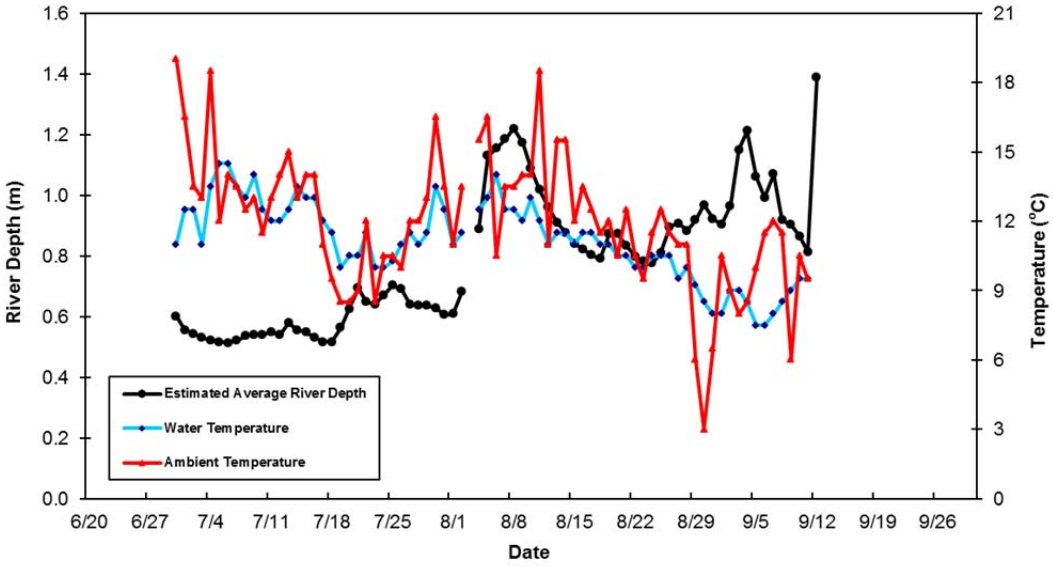

APPENDIX 1.—Estimated average river depth and average daily ambient and water temperatures at the Tuluksak River weir, 2014.

APPENDIX 2.—Daily, cumulative, and cumulative proportion of Chum, Chinook, Sockeye, Pink, and Coho salmon passing through the Tuluksak River weir, Alaska, 2014. Boxed areas represent the second and third-quartile and median passage dates.

	Chum Salmon			Chinook			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportior
6/30	16	16	0.002	4	4	0.013	0	0	0.000	0	0	0.000	0	0	0.000
7/1	56	72	0.008	6	10	0.031	1	1	0.002	2	2	0.004	0	0	0.000
7/2	143	215	0.025	22	32	0.100	5	6	0.012	0	2	0.004	0	0	0.000
7/3	59	274	0.031	17	49	0.153	4	10	0.019	2	4	0.008	0	0	0.000
7/4	53	327	0.037	12	61	0.191	1	11	0.021	0	4	0.008	0	0	0.000
7/5	43	370	0.042	105	166	0.519	4	15	0.029	0	4	0.008	0	0	0.000
7/6	57	427	0.049	13	179	0.559	3	18	0.035	2	6	0.012	0	0	0.000
7/7	4	431	0.049	1	180	0.563	1	19	0.037	1	7	0.014	0	0	0.000
7/8	79	510	0.058	3	183	0.572	13	32	0.062	5	12	0.024	0	0	0.000
7/9	337	847	0.097	4	187	0.584	16	48	0.093	20	32	0.063	0	0	0.000
7/10	312	1,159	0.133	2	189	0.591	34	82	0.160	5	37	0.073	0	0	0.000
7/11	384	1,543	0.177	19	208	0.650	45	127	0.247	7	44	0.087	0	0	0.000
7/12	161	1,704	0.195	13	221	0.691	17	144	0.280	32	76	0.150	0	0	0.000
7/13	175	1,879	0.215	3	224	0.700	24	168	0.327	22	98	0.193	0	0	0.000
7/14	457	2,336	0.268	15	239	0.747	37	205	0.399	24	122	0.240	0	0	0.000
7/15	484	2,820	0.323	4	243	0.759	47	252	0.490	55	177	0.348	0	0	0.000
7/16	117	2,937	0.337	17	260	0.813	12	264	0.514	15	192	0.378	0	0	0.000
7/17	462	3,399	0.390	6	266	0.831	19	283	0.551	13	205	0.404	2	2	0.000
7/18	335	3,734	0.428	6	272	0.850	16	299	0.582	6	211	0.415	1	3	0.000
7/19	314	4,048	0.464	6	278	0.869	7	306	0.595	18	229	0.451	1	4	0.000
7/20	106	4,154	0.476	0	278	0.869	0	306	0.595	1	230	0.453	0	4	0.000
7/21	625	4,779	0.548	7	285	0.891	21	327	0.636	24	254	0.500	2	6	0.000
7/22	362	5,141	0.589	13	298	0.931	15	342	0.665	10	264	0.520	1	7	0.001
7/23	172	5,313	0.609	3	301	0.941	13	355	0.691	9	273	0.537	0	7	0.001
7/24	286	5,599	0.642	1	302	0.944	5	360	0.700	15	288	0.567	2	9	0.001
7/25	247	5,846	0.670	5	307	0.959	9	369	0.718	16	304	0.598	1	10	0.001
7/26	402	6,248	0.716	2	309	0.966	1	370	0.720	18	322	0.634	12	22	0.002
7/27	292	6,540	0.750	2	311	0.972	3	373	0.726	23	345	0.679	3	25	0.002
7/28	88	6,628	0.760	0	311	0.972	4	377	0.733	6	351	0.691	0	25	0.002
7/29	148	6,776	0.777	0	311	0.972	6	383	0.745	8	359	0.707	4	29	0.002
7/30	302	7,078	0.811	1	312	0.975	10	393	0.765	21	380	0.748	10	39	0.003
7/31	205	7,283	0.835	1	313	0.978	5	398	0.774	8	388	0.764	20	59	0.004
8/1	114	7,397	0.848	0	313	0.978	0	398	0.774	9	397	0.781	23	82	0.006
8/2	138	7,535	0.864	0	313	0.978	7	405	0.788	8	405	0.797	14	96	0.007

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	Chum Salmon			Chinook			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
8/3	181	7,716	0.884	0	313	0.978	2	407	0.792	4	409	0.805	75	171	0.012
8/4	305	8,021	0.919	2	315	0.984	16	423	0.823	7	416	0.819	193	364	0.026
8/5	243	8,264	0.947	0	315	0.984	11	434	0.844	5	421	0.829	236	600	0.043
8/6	101	8,365	0.959	0	315	0.984	0	434	0.844	1	422	0.831	171	771	0.056
8/7	33	8,398	0.963	1	316	0.988	1	435	0.846	0	422	0.831	58	829	0.060
8/8	25	8,423	0.965	0	316	0.988	1	436	0.848	0	422	0.831	84	913	0.066
8/9	31	8,454	0.969	1	317	0.991	3	439	0.854	0	422	0.831	115	1,028	0.075
8/10	54	8,508	0.975	1	318	0.994	1	440	0.856	0	422	0.831	177	1,205	0.087
8/11	32	8,540	0.979	0	318	0.994	1	441	0.858	2	424	0.835	185	1,390	0.101
8/12	26	8,566	0.982	1	319	0.997	10	451	0.877	3	427	0.841	121	1,511	0.110
8/13	14	8,580	0.983	0	319	0.997	4	455	0.885	1	428	0.843	42	1,553	0.113
8/14	16	8,596	0.985	0	319	0.997	4	459	0.893	0	428	0.843	83	1,636	0.119
8/15	17	8,613	0.987	0	319	0.997	9	468	0.911	0	428	0.843	84	1,720	0.125
8/16	11	8,624	0.989	0	319	0.997	3	471	0.916	3	431	0.848	134	1,854	0.134
8/17	19	8,643	0.991	0	319	0.997	6	477	0.928	4	435	0.856	359	2,213	0.160
8/18	10	8,653	0.992	0	319	0.997	5	482	0.938	8	443	0.872	1,473	3,686	0.267
8/19	7	8,660	0.993	0	319	0.997	1	483	0.940	2	445	0.876	453	4,139	0.300
8/20	4	8,664	0.993	0	319	0.997	2	485	0.944	2	447	0.880	158	4,297	0.311
8/21	3	8,667	0.993	0	319	0.997	2	487	0.947	2	449	0.884	379	4,676	0.339
8/22	3	8,670	0.994	0	319	0.997	3	490	0.953	2	451	0.888	418	5,094	0.369
8/23	4	8,674	0.994	0	319	0.997	1	491	0.955	1	452	0.890	357	5,451	0.395
8/24	3	8,677	0.995	0	319	0.997	2	493	0.959	5	457	0.900	340	5,791	0.420
8/25	2	8,679	0.995	0	319	0.997	3	496	0.965	3	460	0.906	846	6,637	0.481
8/26	7	8,686	0.996	0	319	0.997	1	497	0.967	4	464	0.913	2,105	8,742	0.634
8/27	2	8,688	0.996	0	319	0.997	1	498	0.969	2	466	0.917	886	9,628	0.698
8/28	2	8,690	0.996	1	320	1.000	1	499	0.971	4	470	0.925	516	10,144	0.735
8/29	3	8,693	0.996	0	320	1.000	3	502	0.977	1	471	0.927	439	10,583	0.767
8/30	1	8,694	0.997	0	320	1.000	1	503	0.979	1	472	0.929	508	11,091	0.804
8/31	3	8,697	0.997	0	320	1.000	1	504	0.981	2	474	0.933	257	11,348	0.822
9/1	3	8,700	0.997	0	320	1.000	2	506	0.984	5	479	0.943	340	11,688	0.847
9/2	2	8,702	0.997	0	320	1.000	0	506	0.984	3	482	0.949	455	12,143	0.880
9/3	1	8,703	0.998	0	320	1.000	7	513	0.998	6	488	0.961	904	13,047	0.946
9/4	0	8,703	0.998	0	320	1.000	0	513	0.998	3	491	0.967	226	13,273	0.962
9/5	4	8,707	0.998	0	320	1.000	0	513	0.998	4	495	0.974	108	13,381	0.970
9/6	3	8,710	0.998	0	320	1.000	0	513	0.998	3	498	0.980	28	13,409	0.972
9/7	2	8,712	0.999	0	320	1.000	0	513	0.998	1	499	0.982	52	13,461	0.976
9/8	6	8,718	0.999	0	320	1.000	1	514	1.000	2	501	0.986	39	13,500	0.978
9/9	0	8,718	0.999	0	320	1.000	0	514	1.000	4	505	0.994	58	13,558	0.983
9/10	6	8,724	1.000	0	320	1.000	0	514	1.000	1	506	0.996	114	13,672	0.991
9/11	2	8,726	1.000	0	320	1.000	0	514	1.000	0	506	0.996	99	13,771	0.998
9/12	0	8,726	1.000	0	320	1.000	0	514	1.000	2	508	1.000	26	13,797	1.000

APPENDIX 3.—Age and sex composition of the Chum Salmon estimated escapement from scale samples (ASL) and video footage for the same stratum and combined strata through the Tuluksak River weir, 2014. Rounding errors affect totals.

		ASL Samples						Video
		Brood Year and Age Group						
		2011	2010	2009	2008	2007		Sex Comp.
		0.2	0.3	0.4	0.5	0.6	Total	Total
Stratum 2:	06/29 – 07/05							
Sampling Dates:	ASL, 07/01, 07/03 − 07/05							
	Video, 06/30 − 07/02							
Male:	Number in Sample:	0	21	29	3	0	53	64
	Estimated % of Escapement:	0.0	25.9	35.8	3.7	0.0	**65.4**	**56.1**
	Estimated Escapement:	0	111	153	16	0	279	240
	Standard Error:	0.0	18.8	20.6	8.1	0.0		
Female	Number in Sample:	2	20	5	1	0	28	50
	Estimated % of Escapement:	2.5	24.7	6.2	1.2	0.0	**34.6**	**43.9**
	Estimated Escapement:	11	105	26	5	0	148	187
	Standard Error:	6.7	18.5	10.3	4.7	0.0		
Total:	Number in Sample:	2	41	34	4	0	81	114
	Estimated % of Escapement:	2.5	50.6	42.0	4.9	0.0	**100.0**	**100.0**
	Estimated Escapement:	11	216	179	21	0	427	427
	Standard Error:	6.7	21.5	21.2	9.3	0.0		
Stratum 3:	07/06 – 07/12							
Sampling Dates:	ASL, 07/06, 07/08 – 07/10							
	Video, 07/10 − 07/11							
Male:	Number in Sample:	4	92	45	2	0	143	169
	Estimated % of Escapement:	1.7	38.3	18.8	0.8	0.0	**59.6**	**60.6**
	Estimated Escapement:	24	557	272	12	0	865	880
	Standard Error:	11.0	41.7	33.5	7.8	0.0		
Female	Number in Sample:	10	67	20	0	0	97	110
	Estimated % of Escapement:	4.2	27.9	8.3	0.0	0.0	**40.4**	**39.4**
	Estimated Escapement:	61	405	121	0	0	587	572
	Standard Error:	17.1	38.5	23.7	0.0	0.0		
Total:	Number in Sample:	14	159	65	2	0	240	279
	Estimated % of Escapement:	5.8	66.3	27.1	0.8	0.0	**100.0**	**100.0**
	Estimated Escapement:	85	962	393	12	0	1,452	1,452
	Standard Error:	20.1	40.6	38.1	7.8	0.0		
Stratum 4:	07/13 – 07/19							
Sampling Dates:	ASL, 07/14, 07/16 – 07/18							
	Video, 07/13 − 07/19							
Male:	Number in Sample:	4	99	30	4	0	137	1,101
	Estimated % of Escapement:	2.0	49.0	14.9	2.0	0.0	**67.8**	**58.2**
	Estimated Escapement:	45	1,115	338	45	0	1,543	1,324
	Standard Error:	21.3	76.6	54.5	21.3	0.0		
Female	Number in Sample:	4	49	12	0	0	65	791
	Estimated % of Escapement:	2.0	24.3	5.9	0.0	0.0	**32.2**	**41.8**
	Estimated Escapement:	45	552	135	0	0	732	951
	Standard Error:	21.3	65.7	36.2	0.0	0.0		
Total:	Number in Sample:	8	148	42	4	0	202	1,892
	Estimated % of Escapement:	4.0	73.3	20.8	2.0	0.0	**100.0**	**100.0**
	Estimated Escapement:	90	1,667	473	45	0	2,275	2,275
	Standard Error:	29.9	67.8	62.2	21.3	0.0		
Stratum 5:	07/20 – 07/26							
Sampling Dates:	ASL, 07/20 – 07/21							
	Video, 07/20, 07/21, 07/23							
Male:	Number in Sample:	3	105	43	2	0	153	260
	Estimated % of Escapement:	1.2	42.0	17.2	0.8	0.0	**61.2**	**65.8**
	Estimated Escapement:	29	1,002	410	19	0	1,460	1,571
	Standard Error:	15.6	70.6	54.0	12.7	0.0		
Female	Number in Sample:	4	72	21	0	0	97	135
	Estimated % of Escapement:	1.6	28.8	8.4	0.0	0.0	**38.8**	**34.2**
	Estimated Escapement:	38	687	200	0	0	926	815
	Standard Error:	18.0	64.8	39.7	0.0	0.0		
Total:	Number in Sample:	7	177	64	2	0	250	395
	Estimated % of Escapement:	2.8	70.8	25.6	0.8	0.0	**100.0**	**100.0**
	Estimated Escapement:	67	1,689	611	19	0	2,386	2,386
	Standard Error:	23.6	65.0	62.4	12.7	0.0		

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		ASL Samples						Video
		Brood Year and Age Group						
		2011	2010	2009	2008	2007		Sex Comp.
		0.2	0.3	0.4	0.5	0.6	Total	Total
Stratum 6:	07/27 – 08/02							
Sampling Dates:	ASL, 07/28 – 08/02							
	Video, 07/28 − 08/02							
Male:	Number in Sample:	1	52	42	1	0	96	145
	Estimated % of Escapement:	0.5	24.6	19.9	0.5	0.0	**45.5**	**49.0**
	Estimated Escapement:	6	290	234	6	0	535	576
	Standard Error:	5.0	31.7	29.4	5.0	0.0		
Female	Number in Sample:	3	84	27	1	0	115	151
	Estimated % of Escapement:	1.4	39.8	12.8	0.5	0.0	**54.5**	**51.0**
	Estimated Escapement:	17	468	150	6	0	641	600
	Standard Error:	8.7	36.0	24.6	5.0	0.0		
Total:	Number in Sample:	4	136	69	2	0	211	296
	Estimated % of Escapement:	1.9	64.5	32.7	0.9	0.0	**100.0**	**100.0**
	Estimated Escapement:	22	758	385	11	0	1,176	1,176
	Standard Error:	10.0	35.2	34.5	7.1	0.0		
Strata 7 − 12:	08/03 – 09/13							
Sampling Dates:	ASL, 08/03, 08/04, 08/13 – 08/17, 08/20							
	Video, 08/03 − 09/11							
Male:	Number in Sample:	2	28	25	0	0	55	393
	Estimated % of Escapement:	1.6	21.7	19.4	0.0	0.0	**42.6**	**41.4**
	Estimated Escapement:	16	219	196	0	0	431	418
	Standard Error:	10.3	34.4	33.0	0.0	0.0		
Female	Number in Sample:	2	52	20	0	0	74	556
	Estimated % of Escapement:	1.6	40.3	15.5	0.0	0.0	**57.4**	**58.6**
	Estimated Escapement:	16	407	157	0	0	579	592
	Standard Error:	10.3	40.9	30.2	0.0	0.0		
Total:	Number in Sample:	4	80	45	0	0	129	949
	Estimated % of Escapement:	3.1	62.0	34.9	0.0	0.0	**100.0**	**100.0**
	Estimated Escapement:	31	626	352	0	0	1,010	1,010
	Standard Error:	14.5	40.5	39.7	0.0	0.0		
Strata 2 − 12:	06/29 – 09/13							
Sampling Dates:	ASL, 07/01 – 08/020							
	Video, 06/30 − 09/11							
Male:	Number in Sample:	14	397	214	12	0	637	2,132
	% Males in Age Group:	2.3	64.4	31.4	1.9	0.0	100	100
	Estimated % of Escapement:	1.4	37.7	18.4	1.1	0.0	**58.6**	**57.4**
	Estimated Escapement:	119	3,293	1,603	98	0	5,113	5,008
	Standard Error:	30.8	123.0	96.8	27.7	0.0		
Female	Number in Sample:	25	344	105	2	0	476	1,793
	% Females in Age Group:	5.2	72.7	21.9	0.3	0.0	100	100
	Estimated % of Escapement:	2.1	30.1	9.1	0.1	0.0	**41.4**	**42.6**
	Estimated Escapement:	187	2,625	790	11	0	3,613	3,718
	Standard Error:	36.0	115.3	71.2	6.9	0.0		
Total:	Number in Sample:	39	741	319	14	0	1,113	3,925
	Estimated % of Escapement:	3.5	67.8	27.4	1.2	0.0	**100.0**	**100.0**
	Estimated Escapement:	306	5,919	2,393	108	0	8,726	8,726
	Standard Error:	47.0	117.5	111.5	28.6	0.0		

APPENDIX 4.— Mean length (mm) from the mid-eye to fork in the caudal fin and age composition of the Chum Salmon escapement through the Tuluksak River weir, 2014.

		Brood Year and Age Group			
		2011	2010	2009	2008
		0.2	0.3	0.4	0.5
Stratum 2:	06/29 – 07/05				
Sampling Dates:	07/01, 07/03 − 07/05				
Male:	Mean Length		613	610	633
	Std. Error		8	7	6
	Range		565 – 680	545 – 695	625 – 645
	Sample Size	0	21	29	3
Female:	Mean Length	563	560	578	610
	Std. Error	33	7	17	
	Range	530 – 595	520 – 620	515 – 615	–
	Sample Size	2	20	5	1
Stratum 3:	07/06 – 07/12				
Sampling Dates:	07/06, 07/08 – 07/10				
Male:	Mean Length	570	610	620	623
	Std. Error	13	4	5	28
	Range	545 – 605	500 – 680	555 – 705	595 – 650
	Sample Size	4	92	45	2
Female:	Mean Length	545	558	577	
	Std. Error	9	3	5	
	Range	495 – 600	490 – 625	530 – 615	
	Sample Size	10	67	20	0
Stratum 4:	07/13 – 07/19				
Sampling Dates:	07/14, 07/16 – 07/18				
Male:	Mean Length	575	588	596	596
	Std. Error	19	4	5	9
	Range	520 – 655	500 – 665	540 – 655	575 – 620
	Sample Size	6	99	30	4
Female:	Mean Length	504	546	555	
	Std. Error	31	5	7	
	Range	410 – 540	455 – 655	515 – 585	
	Sample Size	4	49	12	0
Stratum 5:	07/20 – 07/26				
Sampling Dates:	07/20 – 07/21				
Male:	Mean Length	510	579	592	623
	Std. Error		4	4	8
	Range	–	480 – 690	525 – 675	615 – 630
	Sample Size	3	105	43	2
Female:	Mean Length	543	547	566	
	Std. Error	13	3	7	
	Range	520 – 565	500 – 650	525 – 655	
	Sample Size	4	72	21	0
Stratum 6:	07/27 – 08/02				
Sampling Dates:	07/28 – 08/02				
Male:	Mean Length	480	558	593	590
	Std. Error		6	6	
	Range	–	485 – 655	500 – 700	–
	Sample Size	1	52	42	1
Female:	Mean Length	527	527	549	605
	Std. Error	9	3	5	
	Range	515 – 545	450 – 600	502 – 610	–
	Sample Size	3	84	27	1

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		Brood Year and Age Group			
		2011	2010	2009	2008
		0.2	0.3	0.4	0.5
Strata 7 – 12:	08/03 – 09/13				
Sampling Dates:	08/03, 08/04, 08/13 – 08/17, 08/20				
Male:	Mean Length	495	553	573	
	Std. Error	5	6	6	
	Range	490 – 500	485 – 630	500 – 625	
	Sample Size	2	28	25	0
Female:	Mean Length	503	522	555	
	Std. Error	13	5	7	
	Range	490 – 515	405 – 575	500 – 615	
	Sample Size	2	52	20	0
Strata 2 – 12:	06/29 – 09/13				
Sampling Dates:	07/01 – 08/20				
Male:	Mean Length	546	586	599	614
	Std. Error	12	2	3	7
	Range	480 – 655	480 – 690	500 – 705	575 – 650
	Sample Size	16	397	214	12
Female:	Mean Length	538	541	561	608
	Std. Error	7	2	3	3
	Range	410 – 600	405 – 655	500 – 655	605 – 610
	Sample Size	25	344	105	2

APPENDIX 5.— Age and sex composition of the Chinook Salmon estimated escapement from scale samples (ASL) and archived video footage for all strata combined through the Tuluksak River weir, 2014.

		ASL Sample							Video
		Brood Year and Age Group							
		2010	2009		2008		2007		Sex Comp
		1.2	1.3	2.2	1.4	2.3	1.5	Total	Total
Strata 2 – 10:	06/29 − 08/30								
Sampling Dates:	ASL; 07/01 − 07/07, 07/10 − 07/12, 07/16, 07/21, 07/23, 07/31								
	Video; 06/30 − 07/05, 07/08 − 07/19, 07/21, 07/22, 08/04								
	cont. 08/09, 08/12								
Male:	Number in Sample:	12	22	2	1	1	0	38	148
	% Male in Age Group:	31.6	57.9	5.3	2.6	2.6	0.0	100.0	100.0
	Estimated % of Escapement:	23.1	42.3	3.8	1.9	1.9	0.0	**73.1**	**63.8**
	Estimated Escapement:	74	135	12	6	6	0	234	204
	Standard Error:	17.3	20.3	7.9	5.6	5.6	0.0		
Female	Number in Sample:	0	3	0	9	0	2	14	84
	% Females in Age Group:	0.0	21.4	0.0	64.3	0.0	14.3	100.0	100.0
	Estimated % of Escapement:	0.0	5.8	0.0	17.3	0.0	3.8	**26.9**	**36.2**
	Estimated Escapement:	0	18	0	55	0	12	86	116
	Standard Error:	0.0	9.6	0.0	15.5	0.0	7.9		
Total:	Number in Sample:	12	25	2	10	1	2	52	232
	Estimated % of Escapement:	23.1	48.1	3.8	19.2	1.9	3.8	**100.0**	**100.0**
	Estimated Escapement:	74	154	12	62	6	12	320	320
	Standard Error:	17.3	20.5	7.9	16.2	5.6	7.9		

APPENDIX 6.— Mean length (mm) from the mid-eye to fork in the caudal fin and age composition of Chinook Salmon through the Tuluksak River weir, 2014. Weekly strata were combined and the ASL samples represent 16% of the total Chinook Salmon escapement.

		Brood Year and Age Group					
		2010	2009		2008		2007
		1.2	1.3	2.2	1.4	2.3	1.5
Strata 2 – 10:	06/29 − 08/30						
Sampling Dates:	ASL; 07/01 − 07/07, 07/10 − 07/12, 07/16						
	cont. 07/21, 07/23, 07/31						
Male:	Mean Length	595	718	620	815	595	
	Std. Error	17	10	35			
	Range	445 – 670	635 – 810	585 – 655	–	–	
	Sample Size	12	22	2	1	1	0
Female	Mean Length		650		901		935
	Std. Error		10		19		35
	Range		650 – 660		840 – 985		935 – 1005
	Sample Size	0	3	0	9	0	2

APPENDIX 7.—Age and sex composition of the Sockeye Salmon estimated escapement from scale samples (ASL) and archived video footage for the combined strata through the Tuluksak River weir, 2014. Rounding errors affect totals.

		ASL Samples									Video
		Brood Year and Age Group									
		2011	2010		2009			2008			Sex Comp.
		0.2	0.3	1.2	0.4	1.3	2.2	1.4	2.3	Total	Total
Strata 2 – 12:	06/39 − 09/13										
Sampling Dates:	ASL, 07/02 − 08/16										
	Video, 07/01 − 09/08										
Male:	Number in Sample:	1	3	9	0	24	2	6	0	45	147
	% Male in Age Group:	2.2	6.7	20.0	0.0	53.3	4.4	13.3	0.0	100.0	100.0
	Estimated % of Escapement:	1.1	3.4	10.3	0.0	27.6	2.3	6.9	0.0	**51.7**	**58.1**
	Estimated Escapement:	6	18	53	0	142	12	35	0	266	299
	Standard Error:	5.4	9.2	15.4	0.0	22.6	7.6	12.8	0.0		
Female	Number in Sample:	1	2	4	0	28	4	2	1	42	106
	% Females in Age Group:	2.4	4.8	9.5	0.0	66.7	9.5	4.8	2.4	100.0	100.0
	Estimated % of Escapement:	1.1	2.3	4.6	0.0	32.2	4.6	2.3	1.1	**48.3**	**41.9**
	Estimated Escapement:	6	12	24	0	165	24	12	6	248	215
	Standard Error:	5.4	7.6	10.6	0.0	23.6	10.6	7.6	5.4		
Total:	Number in Sample:	2	5	13	0	52	6	8	1	87	253
	Estimated % of Escapement:	2.3	5.7	14.9	0.0	59.8	6.9	9.2	1.1	**100.0**	**100.0**
	Estimated Escapement:	12	29.5	76.8	0.0	307	35.4	47	5.9	514	514
	Standard Error:	7.6	11.8	18.0	0.0	24.8	12.8	14.6	5.4		

APPENDIX 8.— Mean length (mm) from the mid-eye to fork in the caudal fin and age composition of Sockeye Salmon sampled at the Tuluksak River weir, 2014.

		Brood Year and Age Group							
		2011	2010		2009			2008	
		0.2	0.3	1.2	0.4	1.3	2.2	1.4	2.3
Strata 2 – 12:	06/39 − 09/13								
Sampling Dates:	07/02 − 08/16								
Male:	Mean Length	465	630	553		590	590	640	
	Std. Error		17	16		7	10	2	
	Range	–	600 – 660	480 – 610		510 – 640	580 – 600	630 – 645	
	Sample Size	1	3	9	0	24	2	6	0
Female	Mean Length	565	553	499		558	560	580	585
	Std. Error		18	19		7	13	30	
	Range	–	535 − 570	475 – 555		475 – 635	530 – 595	510 – 610	–
	Sample Size	1	2	4	0	28	4	2	1

APPENDIX 9.—Age and sex composition of the Coho Salmon estimated escapement from scale samples (ASL) and archived video footage for the same stratum and combined strata through the Tuluksak River weir, 2014. The ASL samples represent 4% and the video sample 94% of the total Coho Salmon escapement.

		ASL Samples				Video
		Brood Year and Age Group				
		2011	2010	2009		Sex Comp.
		1.1	2.1	3.1	Total	Total
Strata 4 – 8:	07/13 − 08/18					
Sampling Dates:	ASL, 07/29 − 07/31, 08/02 − 08/04, 08/13 − 08/16					
	Video, 07/29 − 08/16					
Male:	Number in Sample:	42	119	3	164	804
	Estimated % of Escapement:	16.3	46.1	1.2	**63.6**	**53.8**
	Estimated Escapement:	302	855	22	1,179	998
	Standard Error:	39.6	53.5	11.5		
Female	Number in Sample:	22	70	2	94	690
	Estimated % of Escapement:	8.5	27.1	0.8	**36.4**	**46.2**
	Estimated Escapement:	158	503	14	675	856
	Standard Error:	30.0	47.7	9.4		
Total:	Number in Sample:	64	189	5	258	1,494
	Estimated % of Escapement:	24.8	73.3	1.9	**100.0**	**100.0**
	Estimated Escapement:	460	1,358	36	1,854	1,854
	Standard Error:	46.3	47.5	14.8		
Stratum 9:	08/17 − 08/23					
Sampling Dates:	ASL, 08/17, 08/20, 08/22					
	Video, 08/17 − 08/23					
Male:	Number in Sample:	24	60	1	85	2,057
	Estimated % of Escapement:	17.8	44.4	0.7	**63.0**	**59.8**
	Estimated Escapement:	639	1,599	27	2,265	2,150
	Standard Error:	116.6	151.5	26.1		
Female	Number in Sample:	14	36	0	50	1,385
	Estimated % of Escapement:	10.4	26.7	0.0	**37.0**	**40.2**
	Estimated Escapement:	373	959	0	1,332	1,447
	Standard Error:	92.9	134.8	0.0		
Total:	Number in Sample:	38	96	1	135	3,442
	Estimated % of Escapement:	28.1	71.1	0.7	**100.0**	**100.0**
	Estimated Escapement:	1,012	2,558	27	3,597	3,597
	Standard Error:	137.1	138.2	26.1		
Strata 10 – 12:	08/24 − 09/13					
Sampling Dates:	ASL, 08/25, 08/27, 08/29, 09/02					
	Video, 08/24 − 09/12					
Male:	Number in Sample:	37	99	1	137	4,684
	Estimated % of Escapement:	17.2	46.0	0.5	**63.7**	**58.0**
	Estimated Escapement:	1,436	3,843	39	5,318	4,841
	Standard Error:	212.6	280.7	38.3		
Female	Number in Sample:	16	61	1	78	3,391
	Estimated % of Escapement:	7.4	28.4	0.5	**36.3**	**42.0**
	Estimated Escapement:	621	2,368	39	3,028	3,505
	Standard Error:	147.8	253.9	38.3		
Total:	Number in Sample:	53	160	2	215	8,075
	Estimated % of Escapement:	24.7	74.4	0.9	**100.0**	**100.0**
	Estimated Escapement:	2,057	6,211	78	8,346	8,346
	Standard Error:	242.7	245.7	54.1		
Strata 4 – 12:	07/13 − 09/13					
Sampling Dates:	ASL, 07/29 − 09/02					
	Video, 07/29 − 09/12					
Male:	Number in Sample:	103	278	5	386	7,545
	% Male in Age Group:	27.1	71.9	1.0	100.0	100
	Estimated % of Escapement:	17.2	45.6	0.6	**63.5**	**57.9**
	Estimated Escapement:	2,378	6,297	87	8,761	7,989
	Standard Error:	245.6	323.4	47.8		
Female	Number in Sample:	52	167	3	222	5,466
	% Females in Age Group:	22.9	76.1	1.1	100.0	100
	Estimated % of Escapement:	8.4	27.8	0.4	**36.5**	**42.1**
	Estimated Escapement:	1,152	3,830	53	5,036	5,808
	Standard Error:	177.1	291.4	39.5		
Total:	Number in Sample:	155	445	8	608	13,011
	Estimated % of Escapement:	25.6	73.4	1.0	**100.0**	**100.0**
	Estimated Escapement:	3,530	10,127	140	13,797	13,797
	Standard Error:	282.6	285.9	61.8		

APPENDIX 10.—Mean length (mm) from the mid-eye to fork in the caudal fin and age composition of the Coho Salmon estimated escapement through the Tuluksak River weir, 2014. The ASL sample size represents 4% of the total Coho Salmon escapement.

		Brood Year and Age Group		
		2011	2010	2009
		1.1	2.1	3.1
Strata 4 – 8:	07/13 − 08/18			
Sampling Dates:	ASL, 07/29 − 07/31, 08/02 − 08/04, 08/13 − 08/16			
Male:	Mean Length	527	537	605
	Std. Error	6	3	8
	Range	465 – 660	440 – 660	590 – 615
	Sample Size	42	119	3
Female	Mean Length	535	548	573
	Std. Error	6	4	3
	Range	500 – 595	420 – 650	570 – 575
	Sample Size	22	70	2
Stratum 9:	08/17 − 08/23			
Sampling Dates:	ASL, 08/17, 08/20, 08/22			
Male:	Mean Length	533	541	585
	Std. Error	9	5	
	Range	450 – 650	460 – 640	–
	Sample Size	24	60	1
Female	Mean Length	548	566	
	Std. Error	8	5	
	Range	500 – 600	500 – 630	
	Sample Size	14	36	0
Strata 10 – 12:	08/24 − 09/13			
Sampling Dates:	ASL, 08/25, 08/27, 08/29, 09/02			
Male:	Mean Length	541	552	575
	Std. Error	6	4	
	Range	460 – 625	460 – 640	–
	Sample Size	37	99	1
Female	Mean Length	568	541	580
	Std. Error	16	4	
	Range	510 – 780	460 – 605	–
	Sample Size	16	61	1
Strata 4 – 12:	07/13 − 09/13			
Sampling Dates:	ASL, 07/29 − 09/02			
Male:	Mean Length	533	543	595
	Std. Error	4	2	8
	Range	450 – 660	440 – 660	575 – 615
	Sample Size	103	278	5
Female	Mean Length	548	549	575
	Std. Error	6	3	3
	Range	500 – 780	420 – 650	570 – 580
	Sample Size	52	167	3

APPENDIX 11.—Median cumulative passage dates and percent female for Chum, Chinook, Sockeye, Pink and Coho salmon at the Tuluksak River weir 1991–1994 and 2001−2014 (Miller and Harper 2014).

	Chum		Chinook		Sockeye		Pink		Coho	
Year	Date	Percent Female	Date	Percent Female	Date	Percent Female	Date	Percent Female	Date	Percent Female
1991	07/21	48	07/10	29	07/25	–	07/20	–	09/05	53
1992	07/21	50	07/12	15	07/25	43	08/07	–	08/28	43
1993	07/19	24	07/11	14	07/21	49	08/04	–	08/30	43
1994	07/21[a]	51	07/13[a]	24	08/01[a]	83	08/05	–	08/27[a]	38
2001	07/22[a]	44	07/14[a]	–	07/25[a]	–	08/06	–	08/27[a]	46
2002	07/17	44	07/11	24	07/14	–	07/14	–	08/29	58
2003	07/27[a]	33	07/05[a]	27	07/15[a]	63	07/28	–	08/27[a]	52
2004	07/18	43	07/10	37	07/15	–	07/28	–	08/19	32
2005	07/19	39	07/19	35	07/18	–	07/20	–	08/25	51
2006	07/18[a]	48	07/20[a]	28	07/20[a]	–	07/17	–	08/31[a]	54
2007	07/21[a]	31	07/19[a]	48	07/23[a]	40	07/29	–	08/20[a]	36
2008	07/20[a]	42	07/19[a]	41	07/27[a]	54	07/22	–	08/20	41
2009	07/24	30	07/20	43	07/19	49	07/28	–	08/30	31
2010	07/20	30	07/22	26	07/23	67	08/01	–	08/27[a]	56
2011	07/25[a]	34	07/19[a]	26	07/20[a]	56	07/31	–	08/27	–
2012	07/23[a]	51[b]	07/16[a]	33[b]	07/23[a]	64[b]	07/29	–	08/23	54[b]
2013	07/22	35	07/11	39[c]	07/16	63[c]	07/27	–	08/22[a]	39
2014	07/21	41	07/05	27	07/16	48	07/21	24[b]	08/26	37

[a] **Median cumulative passage dates were calculated using estimates for days missed.**
[b] **Percent female was based on video footage.**
[c] **Small ASL collection used in analysis.**