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Abundance and Run Timing of Adult Fall Chum Salmon in the Teedriinjik River, Yukon Flats National Wildlife Refuge, Alaska, 2024

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Cover: Bear tracks in the sand on the bank of the Teedriinjik River.

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Abstract

In 2024, Adaptive Resolution Imaging Sonar (ARIS) was used to assess the abundance of adult fall Chum Salmon *Oncorhynchus keta* in the Teedriinjik River, a tributary of the Yukon River in Alaska. In 2024, sonar was deployed on August 5. Daily operations began on August 6 and continued through September 26. Thirty-minute subsample ARIS sonar recordings from each hour were counted and expanded to estimate hourly passage. During 2024, a total of 1,222.58 hours of acoustic data were analyzed, resulting in 25,601 upriver swimming fish enumerated. After adjusting for missed time, the total fall Chum Salmon passage estimate for 2024 was 51,433 fish (95% confidence interval = 51,304 to 51,562). This 2024 fall Chum Salmon passage estimate is 27.6% of the historical (1995–2024) average of 181,829. The estimate is below the current lower limit of the sustainable escapement goal (SEG) for the Teedriinjik River (SEG range 85,000–234,000). The upriver swimming fall Chum Salmon passage estimate was 439 fish on the first day of counting and 1,817 fish on the last day of counting. The first-quarter point of the run occurred on September 6, the midpoint on September 13, and the third-quarter point on September 20, indicating near-average run timing. Most upriver swimming fish were observed in the nearshore half of the ensonified zones on both banks, and few were observed near the outer range limits of the ensonified zones, suggesting that most fish were within the detection range of the ARIS. These passage estimates are conservative because they only include fish that passed during the dates of sonar operation and within the ensonified portions of the river.

Introduction

The Yukon River drainage encompasses 854,700 km^2 and is among the largest producers of wild Chinook Salmon *Oncorhynchus tshawytscha* and Chum Salmon *O. keta* in North America (Daum and Osborne 1995). The salmon resources of this unique river have historically supported important subsistence and commercial fisheries throughout the drainage. The U.S. Fish and Wildlife Service (USFWS), through Section 302 of the Alaska National Interest Lands Conservation Act and the Yukon River Salmon Agreement, has a responsibility to ensure that salmon populations within federal conservation units are conserved in their natural diversity, subsistence opportunities are maintained, and international treaty obligations are met. Estimating spawning escapements for major salmon stocks in the drainage is essential for addressing these mandates. The Teedriinjik River (formerly known as the Chandalar River) is a tributary of the Yukon River in Alaska. The fall Chum Salmon stock in the Teedriinjik River is one of the largest stocks in the Yukon River drainage (JTC 2016) and is an important resource for wildlife and subsistence users.

Accurate salmon escapement counts on Yukon River tributaries are important for informing and assessing annual harvest management decisions, predicting run strength based on brood year returns, and monitoring long-term population trends. Weirs, counting towers, mark-recapture programs, ground surveys, and hydroacoustics (sonar) are used to obtain escapement estimates of specific Yukon River salmon stocks (Bergstrom et al. 2001).

The use of fixed-location sonar to count migrating salmon in Alaska began during the early 1960s with Bendix sonar units and has provided counts in rivers where limited visibility or size and depth precluded other sampling techniques (Gaudet 1990). The USFWS conducted a 5-year study from 1986 to 1990 using fixed-location Bendix side scanning sonar salmon counters to enumerate adult fall Chum Salmon in the Teedriinjik River. The annual Bendix sonar counts of fall Chum Salmon during that period (1987–1990) averaged 58,457 fish and ranged from 33,619 to 78,631 fish (Appendix A.1). These early Bendix sonar salmon counters were not acoustically calibrated, used factory-set echo-counting criteria to determine fish counts, had limited acoustic range (<33 m), and could not determine the direction of target travel (upriver or downriver). Due to these technological limitations, it is suspected that, overall, the Bendix sonar yielded low estimates of fall Chum Salmon passage on the Teedriinjik River.

A study was initiated in 1994 to reassess the Teedriinjik River fall Chum Salmon population status using split-beam sonar technology. This sonar technology was acoustically calibrated, had user-defined echo-tracking techniques to count fish, and had an extended acoustic range (>100 m). The split-beam sonar also provided three-dimensional positioning for each returning echo, which allowed the determination of direction of travel and swimming behavior for each passing target (Daum and Osborne 1998). Operations during 1994 were used to develop site-specific procedures and methods, evaluate site characteristics, and describe possible data collection biases (Daum and Osborne 1995). In 1995, daily and seasonal estimates of fall Chum Salmon passage were calculated post season and *in situ* target strength evaluations were collected (Daum and Osborne 1996). Fall Chum Salmon enumeration with the split-beam sonar continued through 2006. From 1995 through 2006, fall Chum Salmon passage estimates from split-beam sonar counts averaged 184,388 and ranged from 65,894 to 496,484 (Appendix A.1).

Experimentation to evaluate DIDSON (Dual Frequency Identification Sonar) technology from Sound Metrics (Lake Forest Park, Washington), for enumeration of fall Chum Salmon in the Teedriinjik River was initiated in 2004 and continued through 2006. DIDSON offered some advantages over the previous sonar technologies used on the Teedriinjik River. These included deployment over a wider range of site conditions, production of a more easily interpreted visual image, reduction of training requirements for technicians due to operation and image interpretation that was more intuitive, easier setup and deployment, and the potential for increased capacity for species determination under some conditions. The primary limitations of DIDSON, relative to split-beam sonar, included limited range capabilities, lack of vertical position data, and larger data files requiring large hard drives to store or archive data. During the evaluation period, up to three DIDSON units were set up at different locations, both adjacent to the split-beam sonar, and at independent locations. During these evaluations, the DIDSON produced counts that were similar to those from the split-beam while being less complicated to deploy and operate. Additionally, since fall Chum Salmon are generally shore and bottom oriented during migration in the Teedriinjik River, the lack of vertical position data and the more limited range capabilities of the DIDSON compared to the split-beam were not a hindrance. Conclusions from these evaluations indicated that DIDSON was well suited to enumerate fall Chum Salmon on the Teedriinjik River (Melegari 2008). DIDSON was used on the Teedriinjik

River from 2007 through 2022. From 2007 through 2022, fall Chum Salmon passage estimates from DIDSON counts averaged 192,741 and ranged from 63,095 to 483,833 (Appendix A.1).

In 2022, ARIS (Adaptive Resolution Imaging Sonar, the successor to DIDSON) was operated in conjunction with the DIDSON (Melegari and Maschmann 2025). The DIDSON was used to provide the in-season counts and passage estimate for 2022, and the ARIS was operated side by side to evaluate if it could be a successful replacement for the DIDSON. Pearson Correlation analyses showed that ARIS counts were highly correlated ($r > 0.99$) to DIDSON counts on both banks. DIDSON was thus discontinued and replaced by the ARIS units during the 2023 field season and continued into the 2024 field season.

Objectives of the Teedriinjik River sonar project are to: (1) provide daily in-season passage estimates of Teedriinjik River fall Chum Salmon to fishery managers; (2) estimate annual passage of fall Chum Salmon; and (3) describe annual variability in run size and timing. Since 1996, the project has achieved its objectives each year except 2009, when the project was ended early due to logistical issues, and 2020, when the project was canceled due to the COVID-19 pandemic. Sonar passage estimates from 1995 to 2024 averaged 181,829 fall Chum Salmon and ranged from 19,946 (2021) to 496,484 (2005) fall Chum Salmon (Appendix A.1.1).

Several years of gillnet and beach seine sampling and observations with underwater video cameras suggest that during sonar operations the number of fish of other species in the same size range as fall Chum Salmon is minimal relative to the number of fall Chum Salmon passing (Daum and Osborne 1995, 1996, 1998; Osborne and Melegari 2006; Melegari and Osborne 2007; Melegari 2011, 2012). Therefore, all upriver swimming fish in the size range of fall Chum Salmon detected through sonar are considered to be fall Chum Salmon. Carcass sampling for age, sex, and length data has been conducted on the Teedriinjik River at fall Chum Salmon spawning grounds upstream of the community of Venetie during some years (Appendix A.2). However, this sampling has not been conducted in recent years, including 2024.

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Study Area

The Teedriinjik River is a fifth-order tributary of the Yukon River that drains part of the southern slopes of the Brooks Range. The Teedriinjik River drainage consists of three major branches (Figure 1). These branches are the Teedriinjik River, which includes the main branch from the mouth up to and including the North Fork Teedriinjik River (formerly known as the North Fork Chandalar River), the Ch'idriinjik River (formerly the Middle Fork Chandalar River), and the East Fork Chandalar River (name was not changed in 2015). The sonar site is located on the lower Teedriinjik River, below either of the two branches or any other notable tributaries where salmon would likely spawn (Figure 1). The Teedriinjik River enters the Yukon River approximately 32 km downriver of Fort Yukon. Principal water sources include rainfall, snowmelt, and to a lesser extent, melt water from small glaciers and perennial springs (Craig and Wells 1975). Summer water turbidity is highly variable, depending on rainfall. The region has a continental subarctic climate characterized by some of the largest temperature extremes in the state, -59 °C to 38 °C (USFWS 1987). Precipitation ranges from 15 to 33 cm annually with the greatest amount falling between May and September. The river is typically ice-free by early June and freeze-up typically occurs in early October.

The lower 19-km section of the Teedriinjik River is influenced by a series of slough systems connected to the Yukon River. Riverbanks are typically steep and covered with overhanging vegetation and downed trees caused by active bank erosion. Gravel bars are generally absent in this area and the bottom substrate is primarily sand and silt. Water velocities are generally less than 0.75 m/s. From approximately 21.0 to 22.5 km upriver from its confluence with the Yukon River, the Teedriinjik River is confined to a single channel with steep cut banks alternating with large gravel bars. Substrate in this area is primarily small gravel to cobble with some sand and silt in slow current areas. Upriver from this area, the river becomes braided with many islands and multiple channels. The sonar study area (Figure 2), described in detail by Daum et al. (1992), is located in a single-channel region of the river 21.5 km upriver from the Teedriinjik River's confluence with the Yukon River.

The left bank (facing downriver) ARIS site has a bottom slope of approximately 5° out to approximately 40 m where it flattens out. At the right bank site, the bottom slopes at approximately 7° out to approximately 27 m before it flattens out (Figure 3). Substrate on both banks consists mainly of large gravel. Overall river width at the site varies with water levels and typically ranges from approximately 140 m to 160 m wide.

Methods

Water Quality Monitoring

A staff gauge was installed upstream of the right bank sonar to measure daily water levels and was calibrated using a benchmark established on the right bank in 1989. Water temperatures were taken daily at approximately 1200 hours on each bank using the ARIS temperature gauge.

Site Selection and Sonar Deployment

A sonar deployment site for each bank was selected from several cross-sectional river profiles of the area, developed using a Lowrance (Tulsa, Oklahoma) HDS-7 depth sounder-GPS. Requirements for site selection included: (1) single channel; (2) uniform non-turbulent flow; (3) gradually sloping bottom gradient without sudden inflections; (4) absence of structure or debris that could impede fish detection; (5) location downriver from known salmon spawning areas; and (6) active fish migration past the site (no milling behavior).

The ARIS system is a high-frequency, multiple-beam sonar, with a field of view of 28° x 14° (Sound Metrics Corp. n.d.-a, n.d.-b). ARIS 1800 and ARIS 1200 models were used in 2024. The ARIS 1800 (standard-range model) was operated at a frequency of 1.1 MHz and had an effective range of approximately 30 m. The ARIS 1200 (long-range model) was operated at a frequency of 0.7 MHz, with an effective range of approximately 60 m. Based on detection of known targets drifted through the sonar beams (see below for explanation), and from analysis of fish range data, we are confident that both sonars effectively enumerated fall Chum Salmon on the Teedriinjik River. ARIS specifications are available in the ARIS operation manual (Sound Metrics Corp. n.d.-c). The ARIS units were deployed at fixed locations in the river and communicated with laptop computers for control and data management.

The long-range ARIS was deployed on the left bank and the standard ARIS was used on the right bank. The ARIS units were mounted to aluminum frames and oriented perpendicular to river flow. The mounting brackets allow for manual adjustments to vertical and horizontal aim of the ARIS. The ARIS rotator allows aim via the computer controller for fine adjustments. The aim was adjusted by verifying the detection of targets (i.e., one-liter plastic bottles half filled with steel shot) placed on the river bottom at varying ranges within the ensonified area and drifted from a boat through the ensonified area. Partial weirs, constructed with T-posts and 2 in x 4 in (5.08 cm x 10.16 cm) welded wire fence, were installed approximately 1 m downriver of each ARIS and extended a minimum of 1 m farther offshore than the ARIS location. These weirs directed migrating fish through the beam and prevented fish from passing behind or too close to the ARIS face.

ARIS settings were similar to the DIDSON settings used in previous years and to the ARIS settings used in 2023. Both ARIS models were operated in the low frequency mode (1.1 MHz for the standard range and 0.7 MHz for the long range). The left bank ARIS had a window start setting of 0.68 m, and a window length setting of approximately 41.50 m (the window settings determine the range within which the ARIS acquires data). The right bank had a window start setting of 0.68 m, and a window length setting of approximately 22.00 m. Both banks recorded at 4 frames per second, but the frame rate was lowered to 3 frames in attempt to minimize storage consumption and recording interruptions. With these settings, depending on water levels, approximately 60–70 m in the center of the river was not ensonified.

A wireless network was installed so that all ARIS communications, data acquisition, and analysis for both banks could occur at a single data tent located on the right bank next to the camp. The wireless network and components consisted of two Ubiquiti AirFiber AF-5XHD access points, each paired with an Ubiquiti AirFiber X, AF-5G23-S45 antenna. One access point-antenna pair was connected to the ARIS on the left bank, and the other pair was connected to the receiving computer on the right bank.

Sonar Data Collection and Analysis

In the data tent, a wired network was set up for each ARIS to facilitate data collection and analysis. Each ARIS was networked with a laptop computer and a 4-terabyte network attached storage (NAS) drive. These two computers were used to control and communicate with each ARIS and save the collected data to files on each NAS. A third computer was used to analyze the data and manage data files. Additional backup copies of the count data and summary data files were saved to USB flash drives at the end of each day.

The sonar systems were operated continuously 24 hours per day, except during intermittent periods for maintenance, repairs, aim adjustments, relocation of the ARIS as water levels changed, or during periods of high water and/or heavy debris loads that would impede the safe operation of the sonar equipment. The collected data were saved to files at approximately 30-minute intervals. Data were analyzed using the ARIS control and display software ARIScope and ARISFish (version 5.25.32; Sound Metrics Corp. n.d.-c). Data files were examined in the echogram view and when a potential target was encountered it was further evaluated by reviewing that section of data in the video view to verify the target was a fish exhibiting a typical sinusoidal swimming pattern and to determine direction of travel. Data from counted files were then saved to ASCII text files, which were compiled and summarized using a Microsoft Excel Visual Basic for Applications macro developed by Jeff Melegari. Data from counted files, as well as climate related data, was then entered into a Microsoft Excel database that was used to summarize the count data and share with various partner management agencies.

Because most fish present during sonar operations are fall Chum Salmon, apportionment of sonar counts to fall Chum Salmon was based on relative target size as each fish passed through the ensonified field. All upstream swimming fish that appeared large enough to be a fall Chum

Salmon on the ARIS were assumed to be fall Chum Salmon. While actual length measurements from the ARIS are not precise, relative fish sizes can be observed, and fish that were obviously smaller than fall Chum Salmon were not counted. Conversely, fish larger than typical fall Chum Salmon are very uncommon during sonar operations. Additionally, previous years of beach seining, gillnetting, and underwater video monitoring all indicate that the majority of fish present during sonar operations that are in the same size range as fall Chum Salmon are fall Chum Salmon (Daum and Osborne 1995, 1996, 1998; Osborne and Melegari 2006; Melegari and Osborne 2007; Melegari 2011, 2012).

For each of the 24 hours in a day, ARIS data were collected and used to count passing fish for 30 minutes of each one-hour time period. Then, data from each hour's 30-minute count was used to estimate the number of fish that likely passed during the remaining 30 minutes of the hour that was not physically counted. This was conducted for each of the 24 one-hour periods of each day of sampling.

Count adjustments were made for any time lapses in data acquisition. Partial hourly counts (≥15 and <60 minutes) were standardized to 1 hour, using the formula:

$$E_h = \left(60/T_h \right) \cdot C_h \tag{1}$$

Where E_h = estimated hourly upriver count for hour h, T_h = number of minutes sampled in hour h, and C_h = upriver count during the sampled time during hour h. Counts for hours with less than 15 minutes were discarded and treated as missing hours.

Fish counts for missing hours were estimated from seasonal mean hourly passage percent. Hourly passage percent (proportion (%) of the total daily count passing during a given hour) were determined for all hours in each day from days when all hours were counted. These hourly passage rates were expressed as a proportion (%) of the daily count so high-passage days did not bias results. Then, mean hourly passage percent over the entire season was calculated for each hour. During the season, missing hours were estimated using the averaged mean hourly passage percent from all previous seasons. During post-season analysis, missing hours were re-estimated using the seasonal mean hourly passage percent for that year. Estimated fish counts for missing hours were calculated, using:

$$E_d = \sum R_{di} / \left(100 - \sum R_{di} \right) \cdot T_d \tag{2}$$

Where E_d = estimated upriver fish count for missing hours in day d, R_{di} = mean hourly passage percent for each missing hour i in day d, and T_d = expanded upriver fish count for non-missing hours in day d. Daily upriver fish passage estimates for each bank were calculated by summing all hourly passage estimates for that day. Hourly fish passage rates for each bank were plotted for the season and examined for diel patterns. Range distributions of fish targets were evaluated to assess the likelihood of fish passing beyond the detection range of the ARIS.

When no hourly counts were available for a day, the daily passage count was estimated based on the counts from the sonar on the other bank, if available, or the daily counts before and after the missed period. When only one sonar was inoperable for an entire day, the counts for that sonar were estimated based conservatively on the historical relationship between the two banks. For example, on average, the right bank observed >70% of the total fish passage during the DIDSON years (2007–2008, 2010–2019, and 2021). In 2024, if right bank was inoperable but left bank was still counting, the right bank counts were estimated as equal to left bank passage for that day. If both sonars were inoperable for an entire day, the missing daily counts were interpolated using a linear relationship between the 2 days with counts:

$$E_{di} = C_p + \left(\frac{C_r - C_p}{n_d + 1}\right) i, \tag{3}$$

where E_{di} = the estimated daily count for missing day number i, C_p = the actual or estimated count from the day with at least 1 hourly count immediately preceding the missed days, C_r = the actual or estimated count from the day with at least 1 hourly count immediately following the missed days, and n_d = the number of missed days. The total escapement estimate was the sum of fish counted during the sonar operation period and interpolated missed passage estimates from the above methods.

For calculating the variance of the seasonal estimate, a sample observation consisted of the sum of counts from both banks. If either bank had a missing count during an hour, then we treated that hour as a missed sample observation. Variance (*V*) of the seasonal estimates was calculated using the V5 sample variance estimator suggested by Reynolds et al. (2007):

$$\hat{V} = (1 - f)\left(\frac{1}{n}\right) \sum_{j=5}^{n} \frac{c_j^2}{3.5(n-4)}, \tag{4}$$

Where *f* is the proportion of possible observations that were actually observed,

$$c_j = \frac{y_j}{2} - y_{j-1} + y_{j-2} - y_{j-3} + \frac{y_{j-4}}{2}, \tag{5}$$

and y_j is the *j*th observation of a systematic sample of *n* observations.

A 95% confidence interval for the total seasonal estimate was calculated using the normal interval estimator also recommended by Reynolds et al. (2007):

$$95\%\ CI = \hat{Y} \pm 1.96\sqrt{(\hat{V}(\hat{Y}))}, \tag{6}$$

Where *Y* is the seasonal passage estimate and *V* is the variance of the seasonal passage estimate. The 95% confidence interval only includes the variance associated with subsampling and does not include any other sources of error. The 30-minute sampling protocol produced small variance estimates and tight confidence intervals. During simulations of this sampling protocol using data from the 2011 to 2013 seasons, the 95% confidence intervals for the seasonal passage estimates included the actual value from the full count for all 3 years (Melegari 2015).

Results

Water Monitoring

Calibrated daily water levels ranged from 0.37 to 3.18 m (average 2.05 m) (Figure 4; Table A.3.1). River width at the sonar deployment site ranged from 137 to 151 m. Daily water temperatures ranged from 4.3 °C to 16.2 °C (average 9.6 °C) (Figure A.3.1).

Site Selection and Sonar Deployment

Several cross-sectional profiles were recorded on each bank near deployment locations from previous seasons and the sonar units were deployed where the bottom profiles were considered best for counting fish with the ARIS. The same approximate locations on both banks that have been used since 2007, when operations switched to DIDSON, were used again in 2024, as minimal changes in physical conditions have been observed at these locations between years.

Sonar Data Collection and Analysis

In 2024, data collection operations began at 12:00:01 am on August 6 and continued through 11:59:59 on September 26, for a total of 52 days. Operations consisted of the ARIS recording 24 hours a day in 30-minute intervals per each one-hour period on both banks, resulting in approximately 12 hours of counts per 24-hour operational day. Data were collected and analyzed for 603.75 hours on the left bank, and 618.83 hours on the right bank, resulting in a total of 1,222.58 hours of sonar data. There were 20.23 hours of missed counting on the left bank and 5.17 hours missed on the right bank. No full days were missed in 2024. In 2024, missed counts were primarily due to equipment maintenance or malfunctions. A total of 25,910 (unadjusted for missed time) fish were counted during the season. Upriver swimming fish accounted for 99% (25,601) of the total with downriver fish accounting for the rest (Table 1). Upriver swimming fish counts were 8,229 for the left bank and 17,372 for the right bank.

After adjusting for missed time, and adjusting the 12-hour counts to 24-hour counts, the estimated fall Chum Salmon passage for 2024 was 51,433 fish (95% confidence interval of 51,304 to 51,562; Table 2; Table A.4.1). The left bank estimate was 16,907 fall Chum Salmon, accounting for 32.9% of the total. The right bank estimate was 34,526 fall Chum Salmon accounting for 67.1% of the total. On the first day of sonar operation, the adjusted count was 439 upriver swimming fall Chum Salmon (0.9% of the total), and on the final day of counting, the adjusted count was 1,817 upriver swimming fall Chum Salmon (3.5% of the total). Peak daily passage occurred on September 6 (Table 2; Figure 5). The first-quarter point of the run occurred on September 6, the midpoint on September 13, and the third-quarter point on September 20.

Mean hourly passage rates (number of fish estimated to have passed during each hour expressed as a proportion of the daily estimate) of upriver swimming fall Chum Salmon showed a notable diel pattern on both the right and left bank (Figure 6). On the left bank, the pattern displayed higher counts during late night and early morning (approximately 2000–0700 hours). On the right bank, slightly higher passage rates occurred for a few hours during the late morning to early afternoon (approximately 0800–1300 hours).

Range distribution data indicate that upriver swimming fall Chum Salmon were shore-oriented and indicating that most were within the range of sonar detection for both banks. More than 61% of upriver swimming fall Chum Salmon were within the first 5 m on the left bank (max range ~ 41 m), while 48% of fish were within the first 5 m on the right bank (max range ~ 21 m); and more than 95% were within 17 m on the left bank and 14m on the right bank (Figure 7; Figure 8). Downriver swimming fish, while also generally shore-oriented, were more dispersed across the full detection range of the ARIS on both banks.

Discussion

Water Quality Monitoring

Overall, 2024 was a relatively average year for water levels based on the 2001 through 2023 average. Water levels started the season below average then rose drastically on August 20 (Figure 4). The water level rose to a new 2024 maximum recorded height on August 22, then steadily dropped till about the mid-point of the season. Water levels hovered below average until about the ¾ point of the season when water levels rose to about average for the rest of the season. Water temperatures were mostly above average for most of the season but were below average for a week starting August 21 (Figure A.3.1).

Sonar Data Collection and Analysis

The ARIS units performed well overall. No time was missed due to high water as has occurred in some years; however, some time was missed due to unexplainable interrupted connection between the wireless antennae. Additionally, as in all years, the 2024 estimate should be considered conservative as some fish passed before and after project operation, and it is probable that some fish passed undetected outside of the ensonified zone in the center of the river.

The 2024 passage estimate of 51,433 fall Chum Salmon was 27.6% of the historical average (1995–2022; Figure 9) and fell below the current limits of the sustainable escapement goal (SEG) for the Teedriinjik River (SEG range 85,000–234,000), as revised by the Alaska Department of Fish and Game in 2023.

The sonar counts indicated that run timing in 2024 was slightly later than the historical average. The first-quarter point (September 6) occurred 5 days later than average (1995–2024, excluding 2009 when the project terminated early and 2020 when the project was canceled due to the COVID-19 pandemic); the mid-point (September 13) occurred 3 days later than average; and the third-quarter point (September 20) occurred 4 days later than average. However, timing is similar to more recent year's averages (5-year and 10-year averages; Table A.4.2). The passage estimate on the last day of counting was 1,817 (3.5% of the season total), indicating that, as is usually the case, some fish passage continued after counting stopped. Due to the quickly dropping abundance of upriver fish near the season end and the overall low counts, it is thought that the number of missed fish was low and had only a small effect on the quarter point estimates. As in all years of the project, the 2024 estimate should be considered somewhat conservative as some fish likely passed before and after counting.

The observed diel patterns in upriver fish passage on both banks were similar to most previous years (Figure 6; Daum and Osborne 1998; Melegari and Osborne 2007; Melegari 2019). During most years, the left bank has exhibited a strong diel pattern with higher passage during late night through early morning, whereas the right bank has generally exhibited a weaker pattern with slightly higher passage during mid to late morning, or occasionally no diel pattern.

Higher passage has been observed on the right bank during nearly all years of the project (Table A.1.1). This pattern continued in 2024 with the right bank accounting for 67% of the passage, similar to the 1995 through 2023 (not including 2009 and 2020) historical average of 70% (range 45% to 86%). Enumeration with the ARIS & DIDSON has been able to continue during higher water than what was possible with the split-beam sonar. Observations during these higher water levels have shown a tendency for an increased proportion of fish passage on the left bank. Water levels during 2024 were below average for ¾ of the season (Figure 4).

Fish range data collected with the ARIS were similar to previous years and suggest that most upriver swimming fish passing the sonar site were within the ensonified zone. Upriver swimming fish were found close to shore with relatively few fish found near the outer range limits of sonar detection. This shore orientation is consistent with previous behavioral observations of upriver-migrating fall Chum Salmon on the Teedriinjik (Daum and Osborne 1998; Osborne and Melegari 2006), Sheenjek (Barton 1995) and mainstem Yukon rivers (Johnston et al. 1993; Lozori and McDougall 2016).

Unlike split-beam sonar, ARIS does not obtain vertical fish position data. However, the larger vertical angle of the ARIS beams (14° vs. the 12° of the DIDSON and 2.1–4.8° of the split-beam, previously used on the Teedriinjik River) reduces the potential of fish passing above or below the beams. This is further supported by the ARIS data, in which surface waves, created by boats, debris, or wind, can be detected. Also, the river bottom was typically visible throughout the range.

Conclusions

Annual sonar enumeration of fall Chum Salmon in the Teedriinjik River is a vital component for effectively managing the complex mixed-stock subsistence and commercial fisheries in the Yukon River. The Teedriinjik River fall Chum Salmon stock is crucial to the total Yukon River fall Chum Salmon run and is important to users throughout the drainage. Daily in-season counts and post-season passage estimates provide important escapement information to managers and users of this resource, allowing for better-informed management decisions and evaluation of previous management actions. This project is a key component in assessing the lower river abundance estimate proportioned by mixed-stock genetic analysis. Additionally, this project has provided accurate population status and trend data for 28 years. These time series data will become more important as stressors such as climate change, disease, selective harvest, and overall demand on the fisheries and resources in the Yukon River drainage continue to increase.

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Special appreciation is extended to the people who participated in this project, and who are largely responsible for its success: supervisor Scott Walter and crew members Clare Davis, Charlotte Spaulding, and Lillie Younkins. Others who helped with logistics and field assistance were Shane Ransbury, Keet Lorigan, Harold Garcia, Holly Carroll, Erin McCarthy, Ray Hander, Keith Herron, and Donna Coben. Technical field consultation was provided by Naomi Brodersen. Scott T. Walter, Shane Ransbury, and Anne-Marie Benson provided valuable editorial and statistical review. We also greatly appreciate the logistical support provided by the Yukon Flats National Wildlife Refuge and the Council of Athabascan Tribal Governments in Fort Yukon. Funding for this project was provided through the Yukon River Salmon Treaty Implementation Fund.

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Table 1. — Hydroacoustic data collected via ARIS at the Teedriinjik River, Alaska, 2024.

Date	Left bank sample time (h:mm)	Left bank upriver count	Left bank downriver count	Right bank sample time (h:mm)	Right bank upriver count	Right bank downriver count	Combined sample time (h:mm)	Combined upriver count	Combined downriver count
06-Aug	11:43	122	10	11:55	94	3	23:39	216	13
07-Aug	10:52	66	4	11:49	84	1	22:42	150	5
08-Aug	11:52	42	3	11:55	75	1	23:47	117	4
09-Aug	11:46	34	2	11:55	78	0	23:42	112	2
10-Aug	11:01	26	0	11:55	36	2	22:56	62	2
11-Aug	11:47	18	1	11:55	49	0	23:43	67	1
12-Aug	11:41	23	1	11:55	35	0	23:37	58	1
13-Aug	11:48	17	3	11:55	31	0	23:44	48	3
14-Aug	11:44	18	0	11:55	56	3	23:40	74	3
15-Aug	11:43	14	0	11:55	44	0	23:39	58	0
16-Aug	11:39	23	1	11:55	61	1	23:35	84	2
17-Aug	10:38	25	1	11:55	56	0	22:34	81	1
18-Aug	11:51	25	3	11:55	51	0	23:47	76	3
19-Aug	11:46	43	2	11:55	49	2	23:41	92	4
20-Aug	8:20	35	1	10:55	23	0	19:16	58	1
21-Aug	11:41	70	0	11:55	35	0	23:37	105	0
22-Aug	11:44	82	0	11:55	24	0	23:39	106	0
23-Aug	11:47	102	0	11:54	35	0	23:41	137	0
24-Aug	11:50	137	3	11:55	51	1	23:45	188	4
25-Aug	11:34	99	5	11:55	91	6	23:30	190	11
26-Aug	11:50	102	1	11:55	58	4	23:46	160	5
27-Aug	11:41	101	8	11:55	103	1	23:36	204	9
28-Aug	11:51	81	4	11:55	100	0	23:47	181	4
29-Aug	11:46	93	6	11:55	123	3	23:41	216	9
30-Aug	11:52	125	2	11:55	128	5	23:48	253	7
31-Aug	11:47	86	7	11:55	170	1	23:42	256	8
01-Sep	11:44	91	1	11:55	210	9	23:40	301	10
02-Sep	11:41	98	6	11:55	175	3	23:36	273	9
03-Sep	11:39	155	3	11:55	259	7	23:35	414	10
04-Sep	10:19	160	5	11:55	418	6	22:14	578	11
05-Sep	11:46	126	0	11:55	524	6	23:41	650	6
06-Sep	11:51	258	4	11:55	774	2	23:46	1,032	6
07-Sep	11:48	252	0	11:55	998	6	23:44	1,250	6
08-Sep	11:12	241	5	11:55	642	4	23:07	883	9
09-Sep	11:46	236	2	11:55	627	6	23:41	863	8
10-Sep	11:43	309	2	11:55	691	2	23:39	1,000	4
11-Sep	11:39	237	2	11:55	716	5	23:35	953	7
12-Sep	11:39	213	8	11:54	624	1	23:33	837	9
13-Sep	11:52	212	9	11:55	786	3	23:47	998	12
14-Sep	11:52	278	1	11:54	676	2	23:47	954	3
15-Sep	11:46	254	2	11:55	687	1	23:41	941	3
16-Sep	11:42	260	5	11:55	431	2	23:37	691	7
17-Sep	11:46	312	6	11:55	497	1	23:41	809	7
18-Sep	11:42	313	6	11:55	543	1	23:37	856	7
19-Sep	11:47	315	4	11:54	629	4	23:42	944	8
20-Sep	11:49	281	5	11:55	616	3	23:44	897	8
21-Sep	11:51	301	6	11:54	780	6	23:46	1,081	12
22-Sep	11:46	395	3	11:55	701	2	23:41	1,096	5
23-Sep	11:46	359	9	11:54	684	6	23:41	1,043	15
24-Sep	11:47	346	5	11:54	719	2	23:42	1,065	7
25-Sep	11:48	292	1	11:54	655	6	23:42	947	7
26-Sep	11:41	326	5	11:54	570	6	23:36	896	11
Total	603:46	**8,229**	173	618:50	**17,372**	136	1,222:35	**25,601**	309

Table 2. — Daily fall Chum Salmon upriver adjusted passage estimates in Teedriinjik River, Alaska, 2024.

Date	Left bank	Right bank	Combined	Cumulative	Cumulative %
06-Aug	250	189	439	439	0.85
07-Aug	144	170	313	752	1.46
08-Aug	85	151	236	988	1.92
09-Aug	69	157	226	1,214	2.36
10-Aug	56	72	128	1,342	2.61
11-Aug	36	99	135	1,477	2.87
12-Aug	47	70	117	1,595	3.10
13-Aug	34	62	97	1,691	3.29
14-Aug	37	113	149	1,841	3.58
15-Aug	29	89	117	1,958	3.81
16-Aug	47	123	170	2,128	4.14
17-Aug	55	113	168	2,296	4.46
18-Aug	50	103	153	2,449	4.76
19-Aug	88	99	187	2,636	5.13
20-Aug	117	46	167	2,803	5.45
21-Aug	158	70	236	3,039	5.91
22-Aug	167	48	216	3,255	6.33
23-Aug	207	70	278	3,532	6.87
24-Aug	278	103	380	3,913	7.61
25-Aug	205	183	388	4,301	8.36
26-Aug	207	117	323	4,624	8.99
27-Aug	207	207	414	5,038	9.80
28-Aug	164	201	365	5,403	10.51
29-Aug	189	248	437	5,840	11.35
30-Aug	252	258	510	6,350	12.35
31-Aug	176	342	518	6,869	13.35
01-Sep	185	423	608	7,477	14.54
02-Sep	203	352	556	8,032	15.62
03-Sep	316	521	838	8,870	17.25
04-Sep	353	842	1,195	10,065	19.57
05-Sep	257	1,055	1,312	11,377	22.12
06-Sep	523	1,558	2,081	13,457	26.16
07-Sep	512	2,009	2,521	15,979	31.07
08-Sep	524	1,246	1,770	17,749	34.51
09-Sep	485	1,220	1,706	19,454	37.82
10-Sep	633	1,015	1,648	21,102	41.03
11-Sep	486	1,442	1,928	23,030	44.78
12-Sep	439	1,257	1,697	24,727	48.08
13-Sep	429	1,582	2,011	26,738	51.99
14-Sep	562	1,362	1,924	28,662	55.73
15-Sep	519	1,383	1,902	30,564	59.42
16-Sep	532	868	1,400	31,963	62.14
17-Sep	634	1,001	1,634	33,598	65.32
18-Sep	641	1,093	1,735	35,333	68.70
19-Sep	638	1,267	1,905	37,237	72.40
20-Sep	573	1,236	1,809	39,047	75.92
21-Sep	609	1,571	2,181	41,227	80.16
22-Sep	803	1,412	2,215	43,442	84.46
23-Sep	730	1,378	2,108	45,550	88.56
24-Sep	705	1,449	2,153	47,704	92.75
25-Sep	593	1,320	1,913	49,616	96.47
26-Sep	669	1,148	1,817	51,433	100.00
Totals	16,907	34,526	51,433		

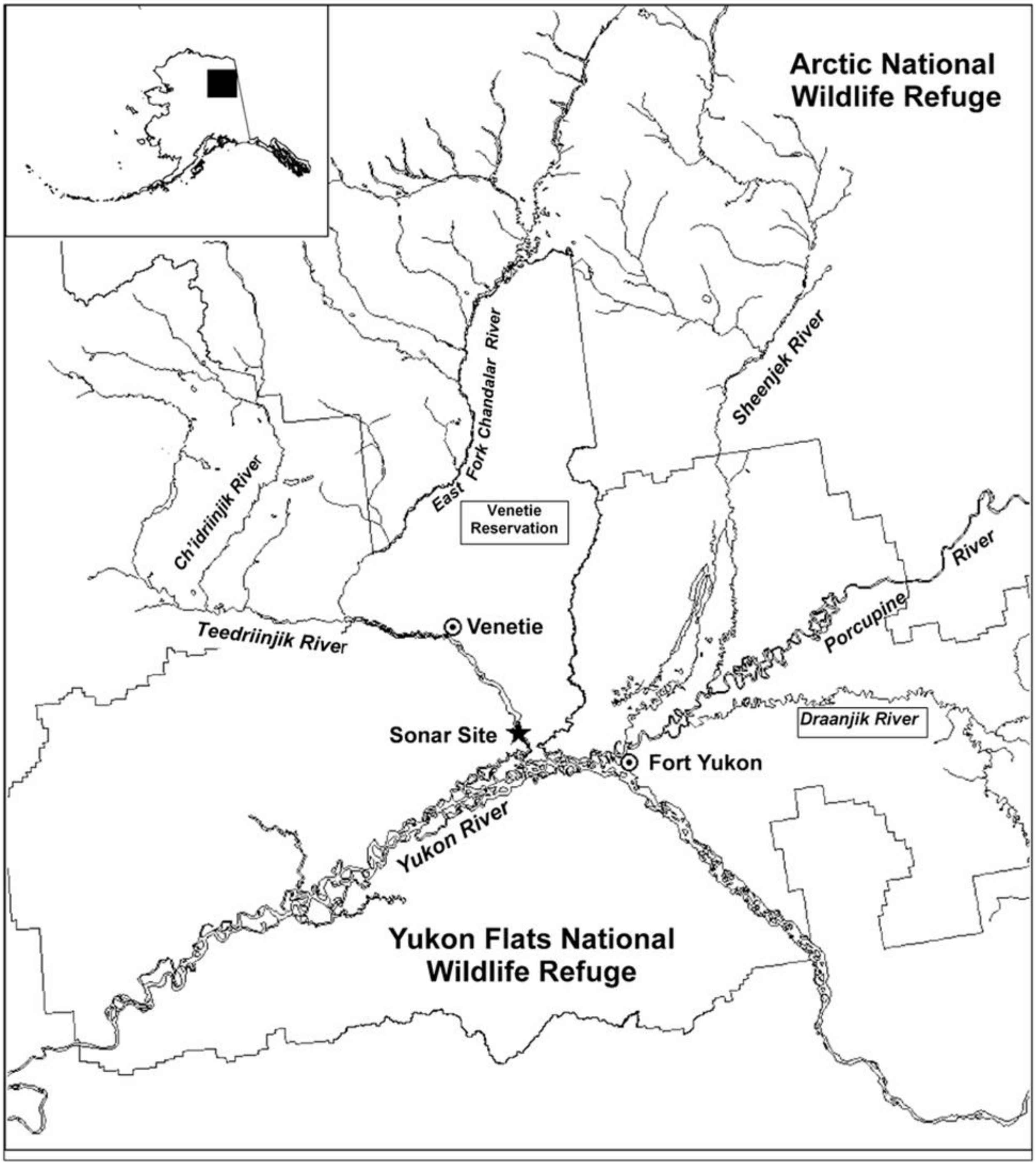


Figure 1. — Teedriinjik River sonar site and major tributaries of the Yukon River near the U.S.-Canada border.

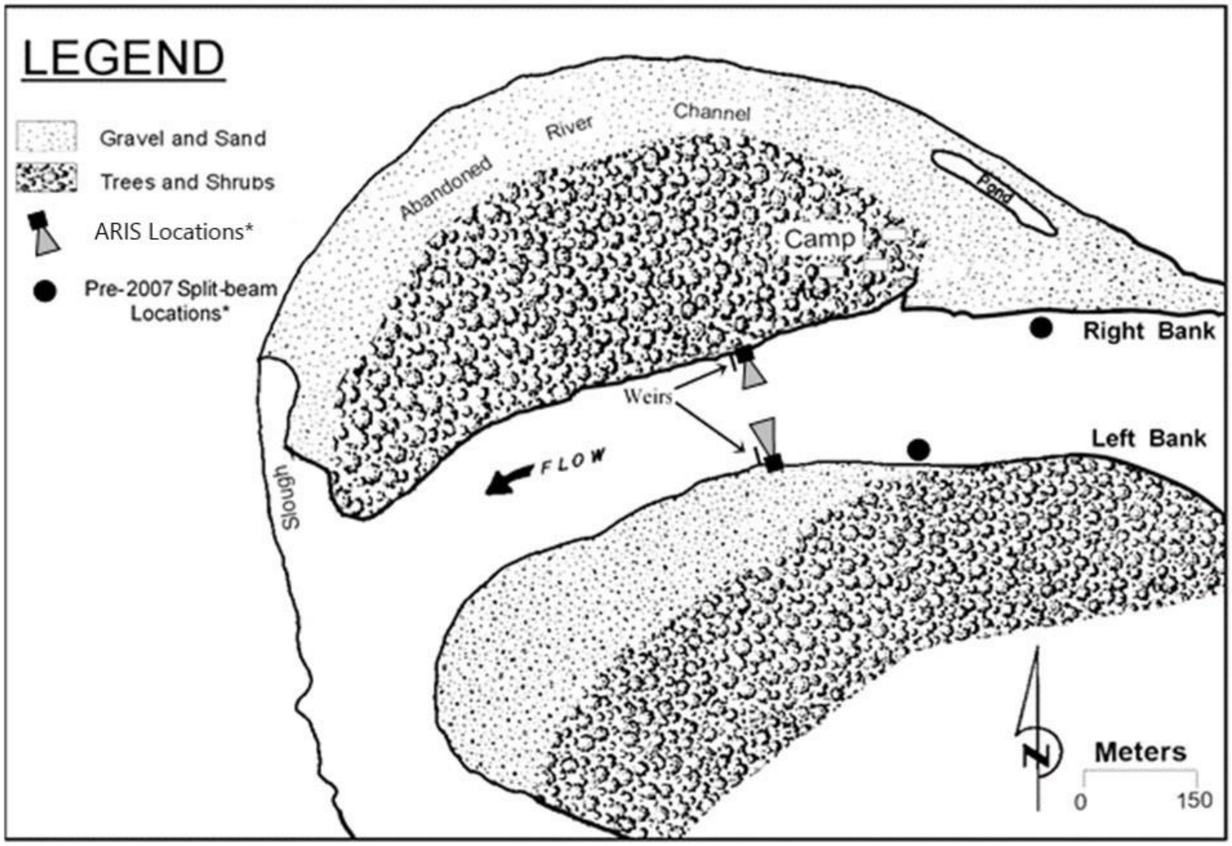


Figure 2. — Site map of Teedriinjik River sonar facilities. *Sonar locations are approximate.

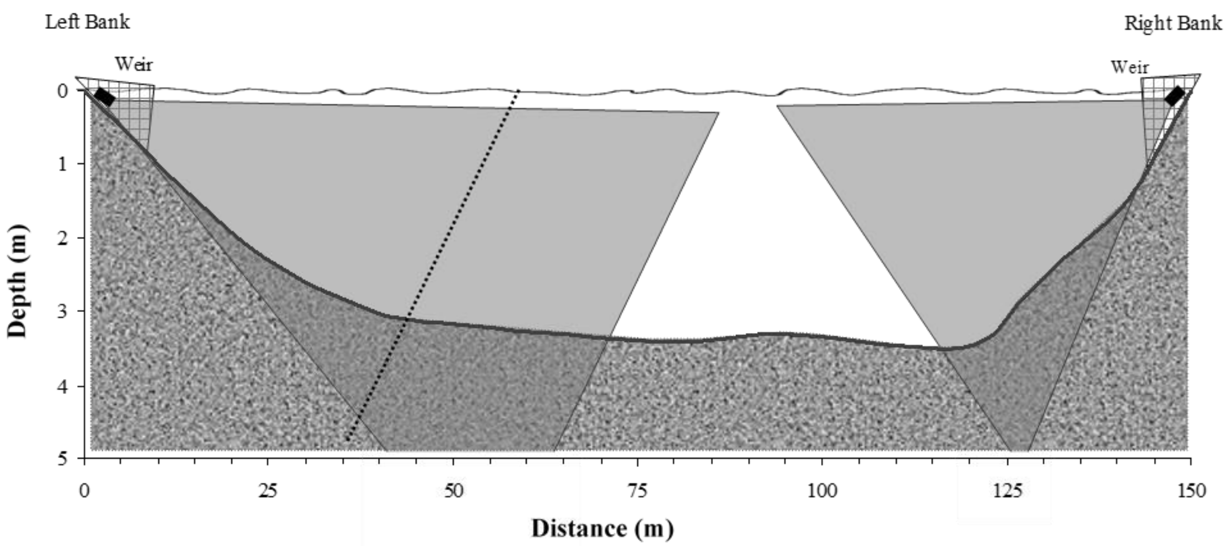


Figure 3. — River channel profile and approximated ensonified zones during 2009 for the left and right bank sonar sites, Teedriinjik River. Little change has occurred in the channel profile from 2008 through 2024. Dotted line on left bank indicates the approximate limit of the ensonified zone with the range reduced to 40 m. Note: different axis scales are used to enhance readability.

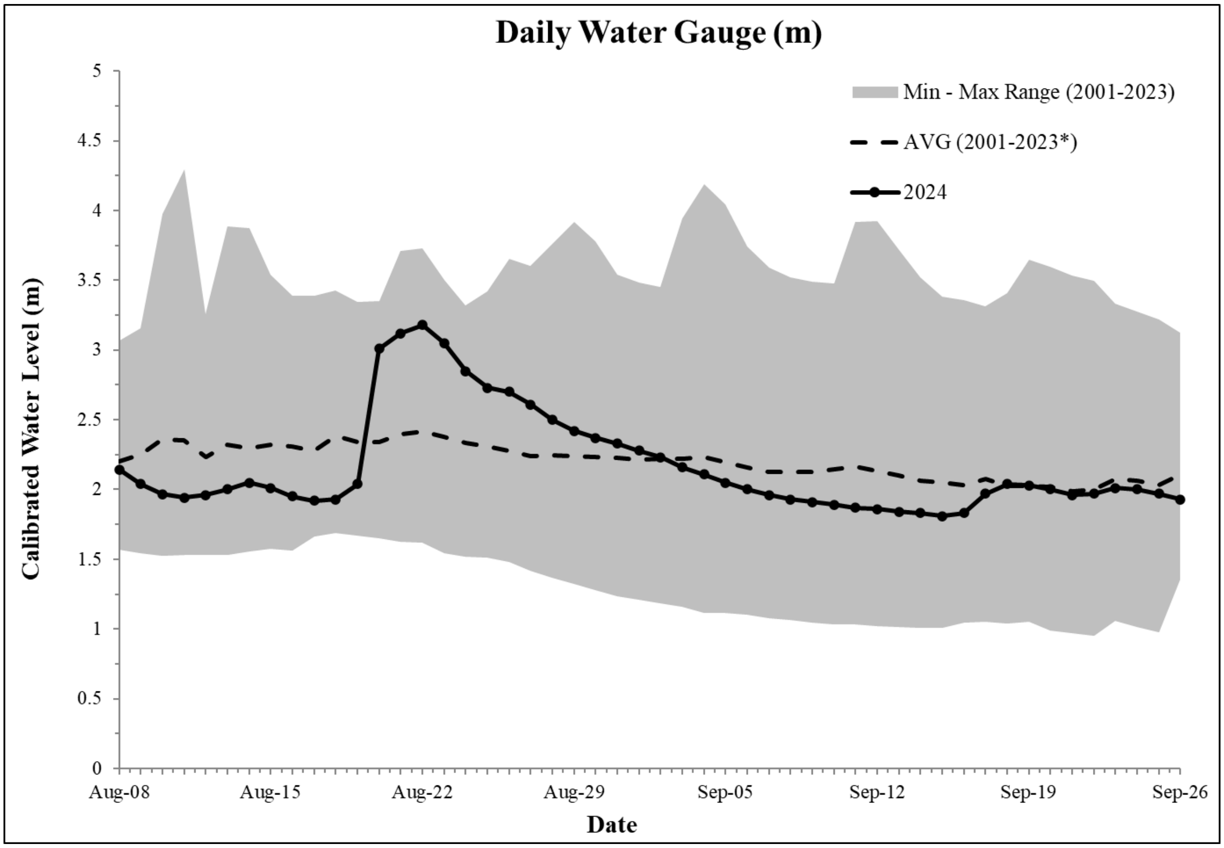


Figure 4. — Daily calibrated water levels from the Teedriinjik River sonar site, 2024. Grey shaded area represents historical range of minimum and maximum water levels. *Historical min-max ranges and averages do not include data from 2003, 2005, 2006, 2009, and 2020.

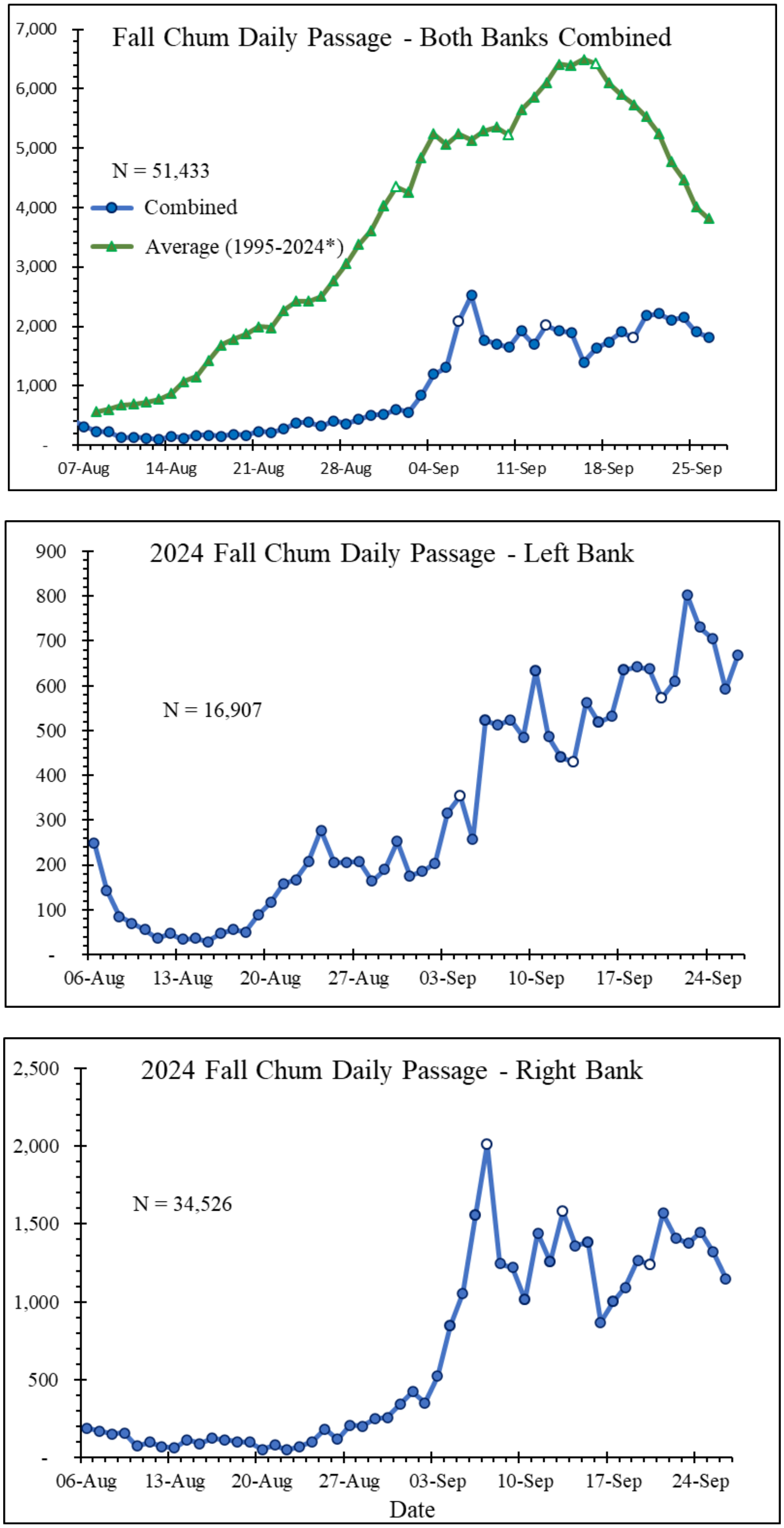
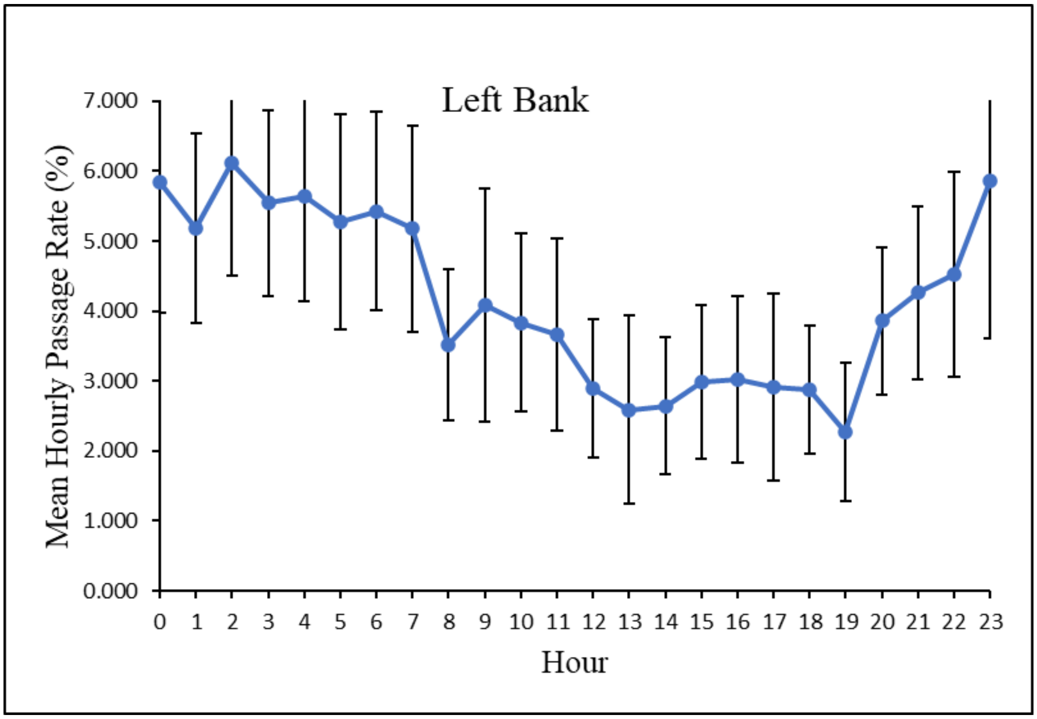


Figure 5. — Estimated passage of upriver swimming fall Chum Salmon both banks combined (top) and by bank (middle and bottom), Teedriinjik River, 2024. White points indicate the first-quarter, mid, and third-quarter points of passage. *Average does not include data from 2009 because the project prematurely ended before the run occurred, and 2020 due to the COVID-19 pandemic.



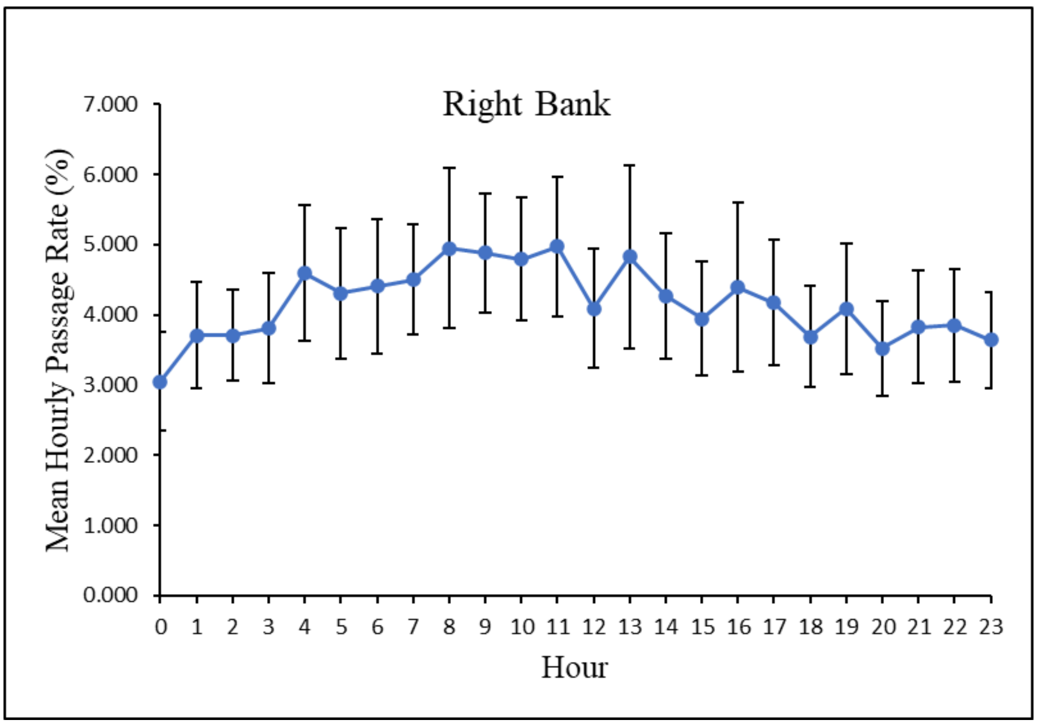


Figure 6. — Mean (±2 SE) hourly passage rate (expressed as a percent of the total daily estimate) of upriver swimming fall Chum Salmon, Teedriinjik River, 2024. Results include 45 days of complete sampling (no missing hours in a day) on the left bank and 50 days on the right bank.

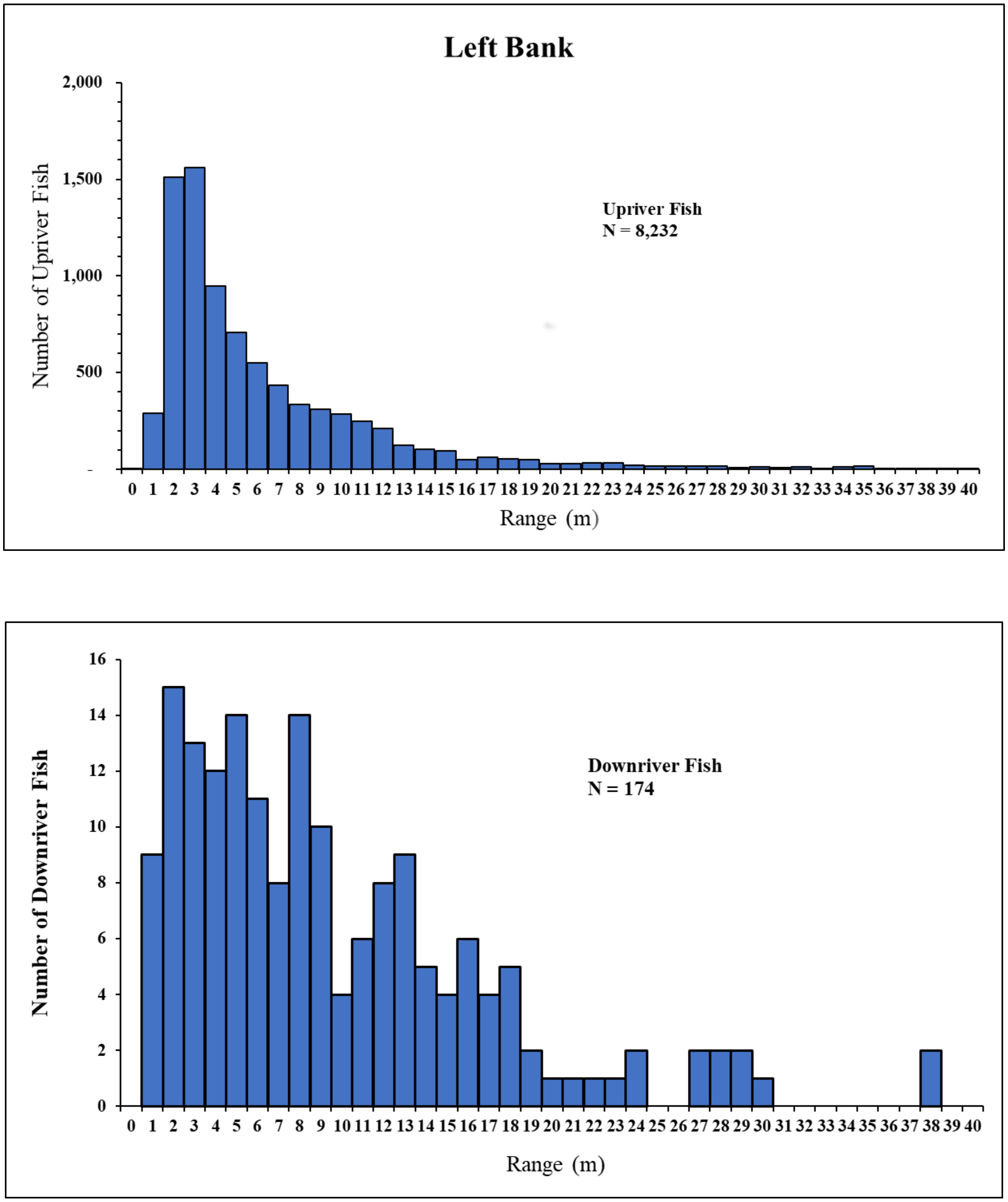
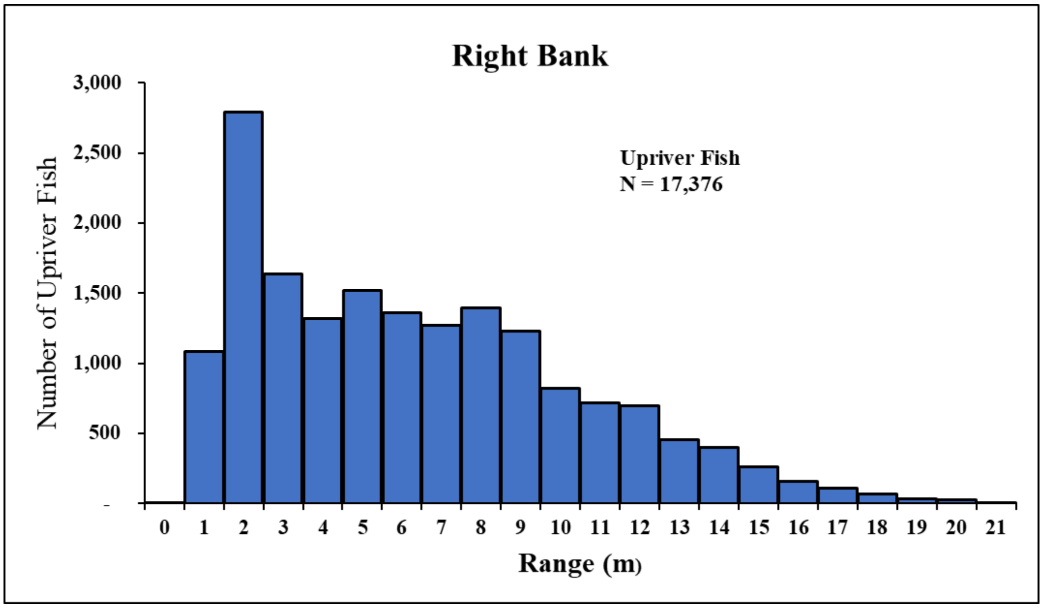


Figure 7. — Range (horizontal distance offshore from ARIS) distribution of upriver and downriver swimming fall Chum Salmon from hydroacoustic data collected on the left bank Teedriinjik River, August 6 through September 26, 2024. Note: different y-axis scales.



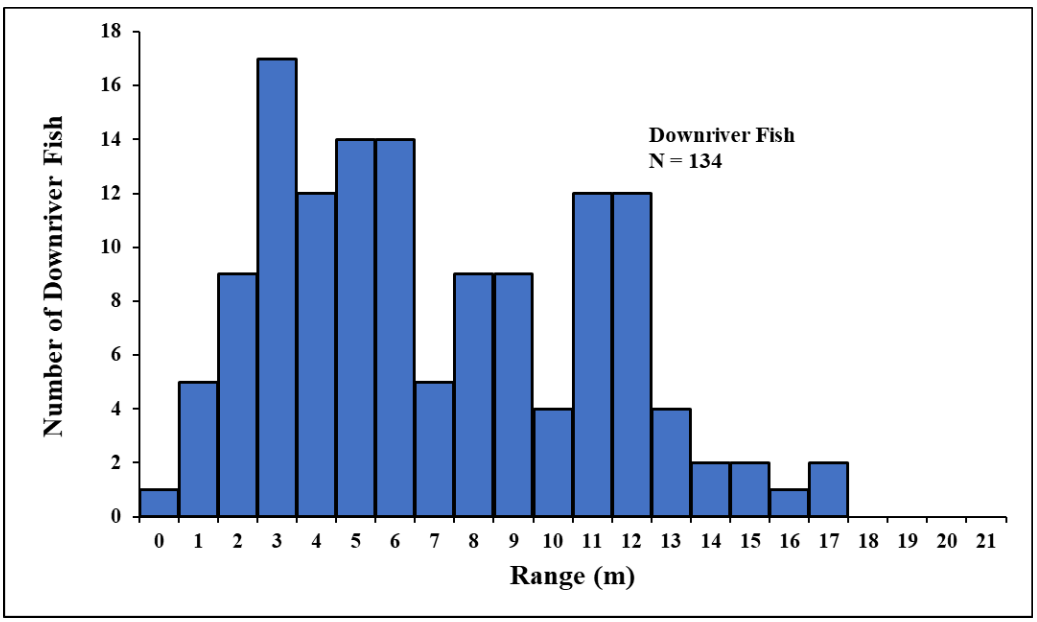


Figure 8. — Range (horizontal distance from ARIS) distribution of upriver and downriver swimming fall Chum Salmon from hydroacoustic data collected on the right bank Teedriinjik River, August 6 through September 26, 2024. Note: different y-axis scales**.**

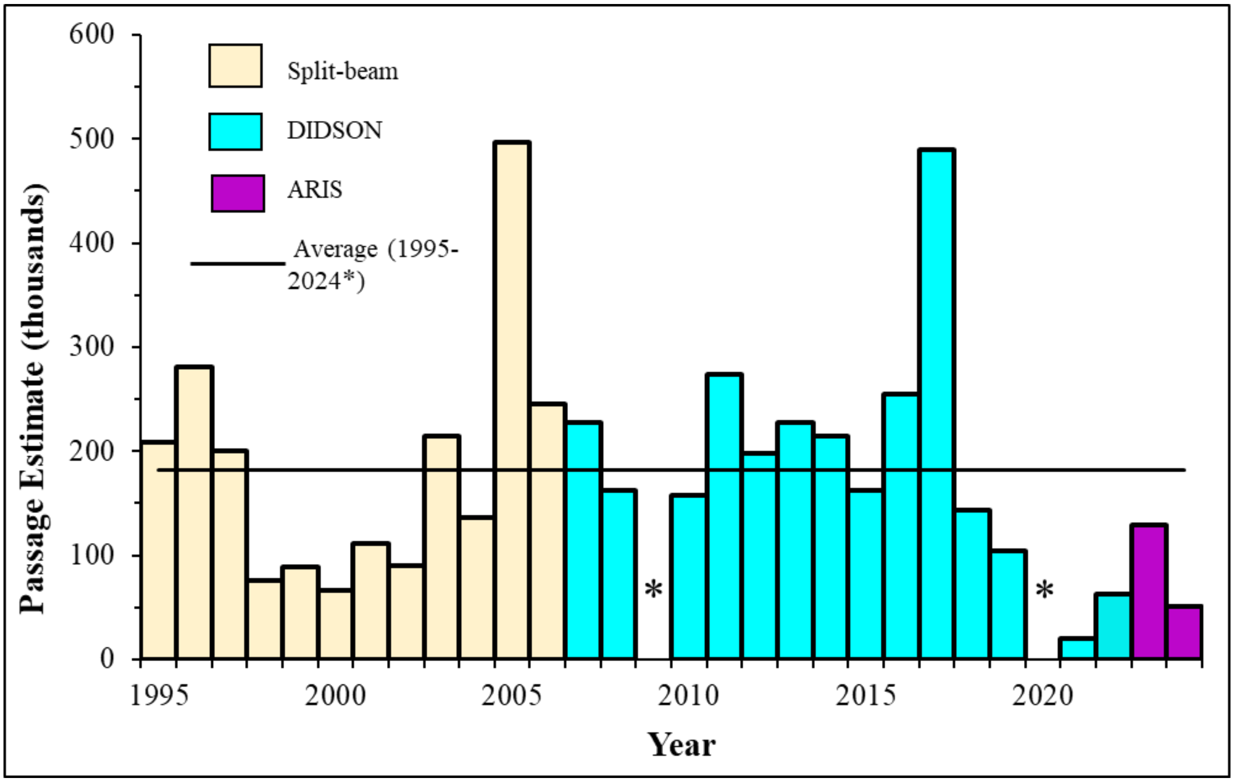


Figure 9. — Annual passage estimates (in thousands of fish) of fall Chum Salmon from sonar counts on the Teedriinjik River, 1995 to 2024. The horizontal line indicates the average of 1995 to 2024 passage estimates. *Average does not include data from 2009 because the project ended early, before most of the run normally passes, or from 2020 when the project was suspended due to the COVID-19 pandemic.

Appendix A.1. Historical Passage

Table A.1.1. — Historical fall Chum Salmon passage estimates from sonar counts on the Teedriinjik River, Alaska. 1995 counts estimated post season. 2009 counts are incomplete due to project ceasing operations early. 2020 was cancelled due the COVID-19 pandemic.

Year	Sonar type	Left bank passage estimate	Right bank passage estimate	Combined passage estimate
1987	Bendix	36,089	16,327	52,416
1988	Bendix	20,516	13,103	33,619
1989	Bendix	36,495	32,666	69,161
1990	Bendix	24,635	53,996	78,631
1995[a]	Split-beam	116,074	164,925	280,999
1996	Split-beam	75,630	132,540	208,170
1997	Split-beam	65,471	134,403	199,874
1998	Split-beam	31,676	44,135	75,811
1999	Split-beam	38,091	50,571	88,662
2000	Split-beam	16,420	49,474	65,894
2001	Split-beam	20,299	90,672	110,971
2002	Split-beam	24,188	65,392	89,580
2003	Split-beam	68,825	145,591	214,416
2004	Split-beam	29,851	106,852	136,703
2005	Split-beam	159,937	336,547	496,484
2006	Split-beam	63,123	181,967	245,090
2007	DIDSON	31,193	196,862	228,055
2008	DIDSON	22,261	139,763	162,024
2009[b]	DIDSON	1,314	4,861	6,175
2010	DIDSON	38,539	119,205	157,744
2011	DIDSON	76,638	197,327	273,965
2012	DIDSON	67,731	130,200	197,931
2013	DIDSON	56,073	171,072	227,145
2014	DIDSON	72,803	141,593	214,396
2015	DIDSON	50,170	112,368	162,538
2016	DIDSON	87,579	166,816	254,395
2017	DIDSON	217,079	266,754	483,833
2018	DIDSON	24,929	118,291	143,220
2019	DIDSON	21,567	82,522	104,089
2020	–	–	–	–
2021	DIDSON	6,079	13,867	19,946
2022	DIDSON	26,752	36,343	63,095
2023	ARIS	68,679	55,499	128,744
2024	ARIS	16907	34526	51433

[a] Estimates calculated post season.

[b] Incomplete counts, operations stopped before most of the run normally passes.

Appendix A.2. Age, Sex, and Length Data

Table A.2.1. — Historical age and sex of fall Chum Salmon carcasses sampled on spawning grounds in the Teedriinjik River, Alaska. Vertebrae were aged by the Alaska Department of Fish and Game. Unknown age indicates the number of samples that could not be aged and were not included in age calculations. Values = *n* (%).

2006 Sex	2006 Sample size	2006 Unknown age	2006 Age 0.2 (brood yr. 2003)	2006 Age 0.3 (brood yr. 2002)	2006 Age 0.4 (brood yr. 2001)	2006 Age 0.5 (brood Yr. 2000)	2006 Age 0.6 (brood yr. 1999)
Female	72(41.1%)	0 (0.0%)	8 (11.1%)	45 (62.5%)	16 (22.2%)	3 (4.2%)	0 (0.0%)
Male	103(58.9%)	0 (0.0%)	6 (5.8%)	69 (67.0%)	28 (27.2%)	0 (0.0%)	0 (0.0%)
Total	175(100.0%)	0 (0.0%)	14 (8.0%)	114 (65.1%)	44 (25.1%)	3 (1.7%)	0 (0.0%)

2008 Sex	2008 Sample size	2008 Unknown age	2008 Age 0.2 (brood yr. 2005)	2008 Age 0.3 (brood yr. 2004)	2008 Age 0.4 (brood yr. 2003)	2008 Age 0.5 (brood Yr. 2002)	2008 Age 0.6 (brood yr. 2001)
Female	102(56.4%)	2 (2.0%)	4 (4.0%)	45 (45.0%)	41 (41.0%)	7 (7.0%)	3 (3.0%)
Male	79(43.6%)	1 (1.3%)	2 (2.6%)	28 (35.9%)	42 (53.8%)	6 (7.7%)	0 (0.0%)
Total	181(100.0%)	3 (1.7%)	6 (3.4%)	73 (41.0%)	83 (46.6%)	13 (7.3%)	3 (1.7%)

2009 Sex	2009 Sample size	2009 Unknown age	2009 Age 0.2 (brood yr. 2006)	2009 Age 0.3 (brood yr. 2005)	2009 Age 0.4 (brood yr. 2004)	2009 Age 0.5 (brood Yr. 2003)	2009 Age 0.6 (brood yr. 2002)
Female	104(57.7%)	0 (0.0%)	10 (9.6%)	70 (67.3%)	23 (22.1%)	1 (0.9%)	0 (0.0%)
Male	76(42.2%)	0 (0.0%)	6 (7.9%)	43 (56.6%)	23 (30.3%)	3 (3.9%)	1 (1.3%)
Total	180(100.0%)	0 (0.0%)	16 (8.8%)	113 (62.8%)	46 (25.6%)	4 (2.2%)	1 (0.6%)

2010 Sex	2010 Sample size	2010 Unknown age	2010 Age 0.2 (brood yr. 2007)	2010 Age 0.3 (brood yr. 2006)	2010 Age 0.4 (brood yr. 2005)	2010 Age 0.5 (brood Yr. 2004)	2010 Age 0.6 (brood yr. 2003)
Female	124(70.1%)	0 (0.0%)	30 (24.2%)	70 (56.5%)	19 (15.3%)	4 (3.2%)	1 (0.8%)
Male	53(29.9%)	0 (0.0%)	7 (13.2%)	33 (62.3%)	11 (20.8%)	2 (3.8%)	0 (0.0%)
Total	177(100.0%)	0 (0.0%)	37 (20.9%)	103 (58.2%)	30 (16.9%)	6 (3.4%)	1 (0.6%)

2011 Sex	2011 Sample size	2011 Unknown age	2011 Age 0.2 (brood yr. 2008)	2011 Age 0.3 (brood yr. 2007)	2011 Age 0.4 (brood yr. 2006)	2011 Age 0.5 (brood Yr. 2005)	2011 Age 0.6 (brood yr. 2004)
Female	277 (51.3%)	6 (2.1%)	4 (1.5%)	161 (61.7%)	92 (35.2%)	14 (5.4%)	0 (0.0%)
Male	263 (48.7%)	3 (1.1%)	3 (1.2%)	116 (44.6%)	126 (48.5%)	15 (5.8%)	0 (0.0%)
Total	540 (100.0%)	9 (1.7%)	7 (1.3%)	277 (52.2%)	218 (41.1%)	29 (5.5%)	0 (0.0%)

Table A.2.2. — Historical length-at-age (mid-eye to fork length (mm)) of female and male fall Chum Salmon carcasses sampled on Teedriinjik River spawning grounds, Alaska.

Year	Age	Female N	Female mean	Female SE	Female median	Female range	Male N	Male mean	Male SE	Male median	Male range
2006	0.2	8	542	13.2	540	480-590	6	573	15.6	585	510-620
2006	0.3	45	551	3.5	550	500-600	69	583	3.8	580	500-655
2006	0.4	16	564	5.6	560	530-600	28	604	6.1	600	550-660
2006	0.5	3	607	18.6	–	570-630	–	–	–	–	–
2006	0.6	0	–	–	–	–	–	–	–	–	–
2006	Total	72					103				
2008	0.2	4	543	19.3	545	500-580	2	540	10	540	530-550
2008	0.3	45	552	3.3	550	510-610	28	575	5.9	570	520-640
2008	0.4	41	578	4	580	530-630	42	608	4.3	605	560-700
2008	0.5	7	560	11.1	560	520-610	6	595	4.3	595	580-610
2008	0.6	3	593	8.8	590	580-610	0	–	–	–	–
2008	Total	100					78				
2009	0.2	10	553	8.8	555	505-590	6	575	14.1	585	510-610
2009	0.3	70	557	2.9	558	500-600	43	584	4.3	580	540-650
2009	0.4	23	565	6.6	570	470-620	23	615	4.8	620	560-660
2009	0.5	1	590	–	590	–	3	607	16.7	590	590-640
2009	0.6	0	–	–	–	–	1	660	–	660	–
2009	Total	104					76				
2010	0.2	30	545	4.6	543	490-610	7	599	6.6	600	575-630
2010	0.3	70	558	3.2	560	500-650	33	605	7.7	610	530-720
2010	0.4	19	568	8.2	570	500-630	11	586	12.1	580	540-670
2010	0.5	4	585	11.9	585	560-610	2	595	15	595	580-610
2010	0.6	1	630	–	630	–	0	–	–	–	–
2010	Total	124					53				
2011	0.2	4	531	11.4	530	505-560	3	558	25.9	535	530-610
2011	0.3	161	562	2.2	560	500-670	116	600	2.9	605	510-660
2011	0.4	92	582	2.7	580	505-645	126	614	2.3	615	555-695
2011	0.5	14	594	8.7	588	550-650	15	612	10.3	620	530-695
2011	0.6	0	–	–	–	–	0	–	–	–	–
2011	Total	271					260				

Appendix A.3. Water Data

Table A.3.1.— Daily staff gauge data collected at the Teedriinjik River sonar project, 2024. Daily gauge readings have been calibrated to a benchmark established on the right bank in 1989.

Date	Staff gauge (m)	Date	Staff gauge (m)	Date	Staff gauge (m)
08/06/2024	2.46	08/24/2023	2.85	09/10/2023	1.89
08/07/2024	2.29	08/25/2023	2.73	09/11/2023	1.87
08/08/2023	2.14	08/26/2023	2.70	09/12/2023	1.86
08/09/2023	2.04	08/27/2023	2.61	09/13/2023	1.84
08/10/2023	1.97	08/28/2023	2.50	09/14/2023	1.83
08/11/2023	1.94	08/29/2023	2.42	09/15/2023	1.81
08/12/2023	1.96	08/30/2023	2.37	09/16/2023	1.83
08/13/2023	2.00	08/31/2023	2.33	09/17/2023	1.97
08/14/2023	2.05	09/01/2023	2.28	09/18/2023	2.04
08/15/2023	2.01	09/02/2023	2.23	09/19/2023	2.03
08/16/2023	1.95	09/03/2023	2.16	09/20/2023	2.00
08/17/2023	1.92	09/04/2023	2.11	09/21/2023	1.96
08/18/2023	1.93	09/05/2023	2.05	09/22/2023	1.97
08/19/2023	2.04	09/06/2023	2.00	09/23/2023	2.01
08/20/2023	3.01	09/07/2023	1.96	09/24/2023	2.00
08/21/2023	3.12	09/08/2023	1.93	09/25/2023	1.97
08/22/2023	3.18	09/09/2023	1.91	09/26/2023	1.93
08/23/2023	3.05				

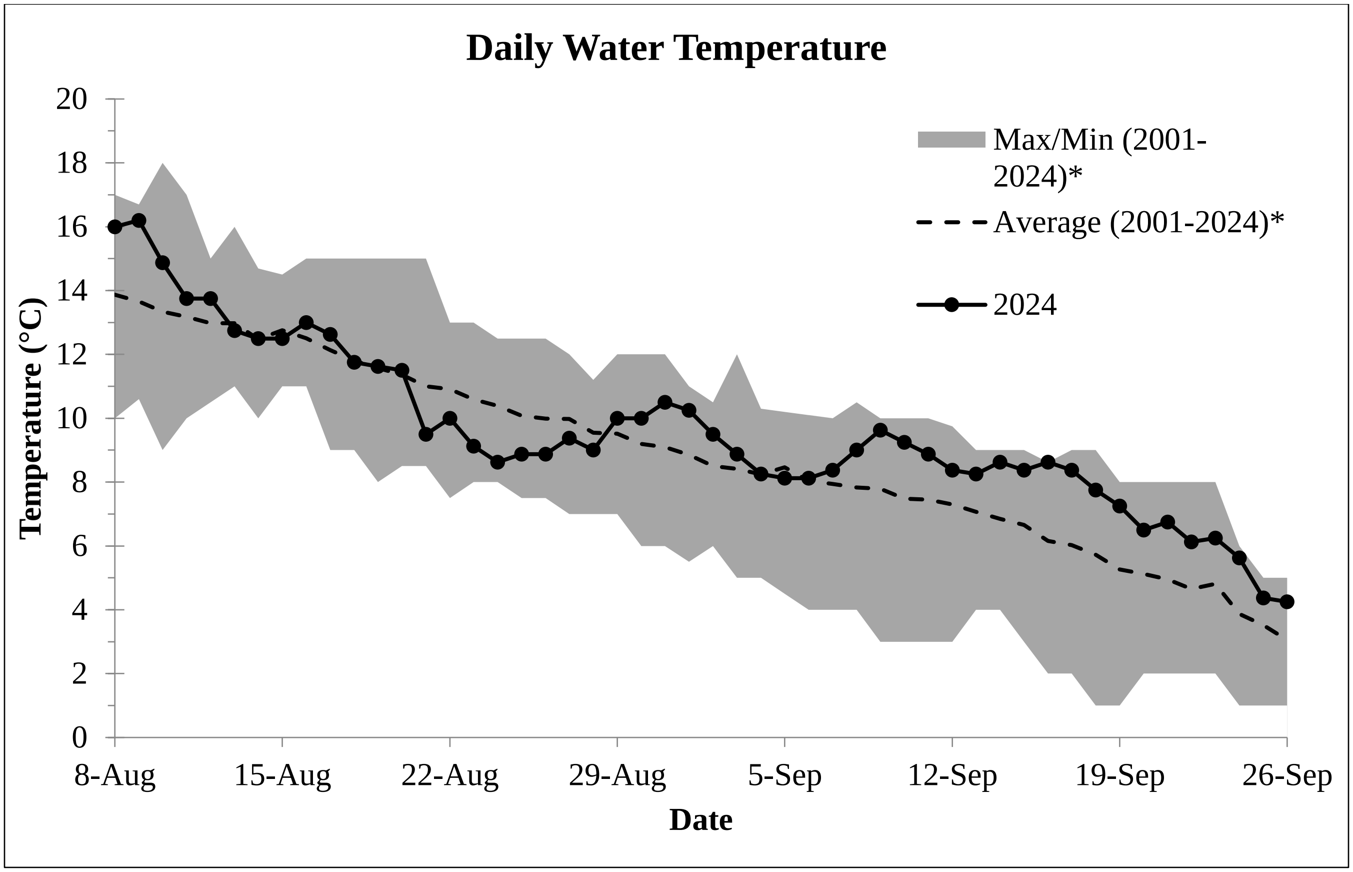


Figure A.3.1. — Daily water temperatures taken with ARIS unit from the Teedriinjik River sonar site, 2024. Gray shaded area represents historical range of min-max temperatures. *Historical min-max and averages do not include data from 2003, 2005, 2007, 2009 and 2020.

Appendix A.4. Historical Passage and Run Timing

Table A.4.1. — Historical daily and cumulative fall Chum Salmon passage estimates from sonar counts on the Teedriinjik River 1995–2024.

Date	1995 Daily	1995 Cum	1996 Daily	1996 Cum	1997 Daily	1997 Cum	1998 Daily	1998 Cum	1999 Daily	1999 Cum
6-Aug										
7-Aug										
8-Aug	1,172	1,172	517	517	619	619	90	90	149	149
9-Aug	928	2,100	341	858	522	1,141	152	242	128	277
10-Aug	861	2,961	323	1,181	682	1,823	215	457	123	400
11-Aug	856	3,817	262	1,443	435	2,258	189	646	119	519
12-Aug	1,269	5,086	356	1,799	752	3,010	162	808	114	633
13-Aug	1,327	6,413	628	2,427	729	3,739	119	927	203	836
14-Aug	1,600	8,013	928	3,355	723	4,462	270	1,197	214	1,050
15-Aug	1,876	9,889	1,209	4,564	838	5,300	395	1,592	368	1,418
16-Aug	1,761	11,650	1,743	6,307	619	5,919	235	1,827	561	1,979
17-Aug	1,672	13,322	2,633	8,940	639	6,558	160	1,987	1,032	3,011
18-Aug	1,741	15,063	3,523	12,463	423	6,981	158	2,145	1,232	4,243
19-Aug	1,851	16,914	4,413	16,876	388	7,369	151	2,296	1,985	6,228
20-Aug	2,297	19,211	5,302	22,178	365	7,734	139	2,435	2,269	8,497
21-Aug	2,729	21,940	6,085	28,263	540	8,274	141	2,576	2,372	10,869
22-Aug	1,988	23,928	6,449	34,712	793	9,067	168	2,744	2,227	13,096
23-Aug	2,596	26,524	7,132	41,844	1,617	10,684	273	3,017	3,266	16,362
24-Aug	6,893	33,417	5,996	47,840	2,263	12,947	318	3,335	3,052	19,414
25-Aug	8,540	41,957	5,165	53,005	3,125	16,072	400	3,735	2,854	22,268
26-Aug	9,666	51,623	6,469	59,474	3,458	19,530	421	4,156	3,679	25,947
27-Aug	6,388	58,011	7,750	67,224	6,103	25,633	486	4,642	3,635	29,582
28-Aug	7,723	65,734	7,572	74,796	5,942	31,575	330	4,972	3,928	33,510
29-Aug	6,842	72,576	6,834	81,630	7,217	38,792	273	5,245	2,961	36,471
30-Aug	8,212	80,788	6,677	88,307	6,661	45,453	651	5,896	2,022	38,493
31-Aug	11,146	91,934	6,737	95,044	6,020	51,473	917	6,813	2,034	40,527
1-Sep	7,229	99,163	7,233	102,277	5,123	56,596	1,230	8,043	1,754	42,281
2-Sep	8,390	107,553	7,982	110,259	4,509	61,105	1,321	9,364	1,974	44,255
3-Sep	8,708	116,261	9,500	119,759	9,720	70,825	1,455	10,819	2,444	46,699
4-Sep	6,136	122,397	7,572	127,331	10,468	81,293	1,379	12,198	2,571	49,270
5-Sep	4,308	126,705	5,837	133,168	13,069	94,362	1,505	13,703	3,716	52,986
6-Sep	3,991	130,696	6,086	139,254	15,951	110,313	1,630	15,333	4,767	57,753
7-Sep	5,354	136,050	6,132	145,386	15,420	125,733	1,675	17,008	3,965	61,718
8-Sep	5,795	141,845	8,090	153,476	12,953	138,686	1,824	18,832	2,775	64,493
9-Sep	3,859	145,704	9,847	163,323	8,872	147,558	2,128	20,960	1,743	66,236
10-Sep	5,087	150,791	9,422	172,745	7,602	155,160	2,429	23,389	1,417	67,653
11-Sep	3,825	154,616	9,870	182,615	5,458	160,618	2,503	25,892	1,227	68,880
12-Sep	3,728	158,344	9,263	191,878	4,660	165,278	2,512	28,404	1,195	70,075
13-Sep	5,764	164,108	10,708	202,586	4,109	169,387	2,723	31,127	1,238	71,313
14-Sep	3,672	167,780	10,095	212,681	3,956	173,343	2,524	33,651	1,363	72,676
15-Sep	3,739	171,519	9,527	222,208	3,900	177,243	2,273	35,924	1,133	73,809
16-Sep	6,104	177,623	8,324	230,532	4,124	181,367	2,747	38,671	1,357	75,166
17-Sep	7,063	184,686	8,439	238,971	4,264	185,631	4,999	43,670	1,340	76,506
18-Sep	5,089	189,775	8,274	247,245	3,656	189,287	5,935	49,605	1,352	77,858
19-Sep	5,819	195,594	8,086	255,331	3,513	192,800	4,731	54,336	1,332	79,190
20-Sep	4,186	199,780	7,836	263,167	2,320	195,120	4,401	58,737	1,510	80,700
21-Sep	4,086	203,866	9,605	272,772	2,428	197,548	4,053	62,790	1,324	82,024
22-Sep	4,304	208,170	8,227	280,999	2,326	199,874	3,329	66,119	1,628	83,652
23-Sep							2,738	68,857	1,490	85,142
24-Sep							2,498	71,355	1,362	86,504
25-Sep							2,336	73,691	1,112	87,616
26-Sep							2,103	75,794	1,046	88,662
27-Sep										
28-Sep										
29-Sep										

Table A.4.1. — Continued.

Date	2000 Daily	2000 Cum	2001 Daily	2001 Cum	2002 Daily	2002 Cum	2003 Daily	2003 Cum	2004 Daily	2004 Cum
6-Aug										
7-Aug										
8-Aug	226	226	454	454	216	216	310	310	880	880
9-Aug	232	458	368	822	665	881	395	705	907	1,787
10-Aug	222	680	355	1,177	774	1,655	449	1,154	995	2,782
11-Aug	260	940	317	1,494	600	2,255	872	2,026	991	3,773
12-Aug	200	1,140	385	1,879	905	3,160	894	2,920	1,077	4,850
13-Aug	238	1,378	322	2,201	569	3,729	792	3,712	1,031	5,881
14-Aug	264	1,642	626	2,827	270	3,999	1,193	4,905	921	6,802
15-Aug	216	1,858	969	3,796	623	4,622	1,598	6,503	888	7,690
16-Aug	240	2,098	1,270	5,066	691	5,313	1,980	8,483	1,016	8,706
17-Aug	500	2,598	1,561	6,627	772	6,085	3,551	12,035	1,193	9,899
18-Aug	451	3,049	7,024	13,651	641	6,726	3,747	15,781	1,350	11,249
19-Aug	460	3,509	5,108	18,759	959	7,685	3,294	19,076	1,374	12,623
20-Aug	665	4,174	3,164	21,923	683	8,368	3,015	22,091	1,610	14,233
21-Aug	621	4,795	2,576	24,499	469	8,837	4,363	26,454	1,488	15,721
22-Aug	706	5,501	2,279	26,778	481	9,318	5,789	32,243	1,230	16,951
23-Aug	591	6,092	2,902	29,680	604	9,922	6,427	38,671	1,555	18,506
24-Aug	2,270	8,362	2,744	32,424	700	10,622	5,237	43,908	981	19,487
25-Aug	1,616	9,978	2,630	35,054	721	11,343	4,537	48,445	787	20,274
26-Aug	1,231	11,209	2,272	37,326	1,074	12,417	3,992	52,436	699	20,973
27-Aug	1,051	12,260	2,282	39,608	1,260	13,677	5,073	57,509	738	21,711
28-Aug	1,742	14,002	1,940	41,548	1,644	15,321	6,170	63,680	1,602	23,313
29-Aug	1,598	15,600	2,728	44,276	2,230	17,551	7,896	71,576	2,485	25,798
30-Aug	1,303	16,903	2,066	46,342	1,722	19,273	7,980	79,556	2,622	28,420
31-Aug	1,943	18,846	2,359	48,701	2,790	22,063	7,828	87,384	3,985	32,405
1-Sep	2,601	21,447	2,307	51,008	2,541	24,604	7,639	95,023	5,247	37,652
2-Sep	1,981	23,428	2,575	53,583	2,281	26,885	6,812	101,834	4,910	42,562
3-Sep	2,021	25,449	2,478	56,061	1,977	28,862	7,357	109,191	5,953	48,515
4-Sep	2,159	27,608	3,421	59,482	2,038	30,900	10,955	120,146	7,167	55,682
5-Sep	2,150	29,758	3,540	63,022	1,389	32,289	8,978	129,124	4,438	60,120
6-Sep	2,262	32,020	3,086	66,108	1,458	33,747	7,050	136,174	5,357	65,477
7-Sep	1,902	33,922	4,437	70,545	1,530	35,277	4,667	140,842	6,344	71,821
8-Sep	1,983	35,905	3,860	74,405	1,780	37,057	3,387	144,229	6,053	77,874
9-Sep	1,650	37,555	3,746	78,151	1,857	38,914	3,899	148,127	5,308	83,182
10-Sep	1,791	39,346	4,176	82,327	1,981	40,895	5,659	153,786	4,473	87,655
11-Sep	1,921	41,267	3,108	85,435	2,922	43,817	4,856	158,642	5,415	93,070
12-Sep	1,484	42,751	3,311	88,746	2,830	46,647	4,329	162,972	5,491	98,561
13-Sep	1,496	44,247	3,107	91,853	3,410	50,057	3,954	166,926	6,525	105,086
14-Sep	1,517	45,764	2,320	94,173	4,112	54,169	3,795	170,721	5,741	110,827
15-Sep	1,160	46,924	2,208	96,381	4,145	58,314	4,520	175,241	4,055	114,882
16-Sep	1,292	48,216	2,165	98,546	4,152	62,466	4,789	180,030	2,515	117,397
17-Sep	1,225	49,441	2,173	100,719	3,671	66,137	6,049	186,079	1,669	119,066
18-Sep	1,409	50,850	1,696	102,415	4,033	70,170	3,565	189,644	2,280	121,346
19-Sep	1,289	52,139	1,525	103,940	3,490	73,660	2,307	191,951	2,731	124,077
20-Sep	1,690	53,829	1,530	105,470	3,356	77,016	3,592	195,543	2,765	126,842
21-Sep	1,765	55,594	1,293	106,763	2,846	79,862	5,551	201,094	3,401	130,243
22-Sep	1,607	57,201	1,203	107,966	2,174	82,036	3,430	204,524	6,845	137,088
23-Sep	1,113	58,314	1,201	109,167	2,077	84,113	3,047	207,571		
24-Sep	1,280	59,594	786	109,953	2,095	86,208	2,466	210,037		
25-Sep	1,665	61,259	578	110,531	1,904	88,112	2,590	212,627		
26-Sep	1,340	62,599	440	110,971	1,735	89,847	1,801	214,428		
27-Sep										
28-Sep										
29-Sep										

Table A.4.1. — Continued, (no data for 2009, when the project was terminated early, before the majority of the run occurred).

Date	2005 Daily	2005 Cum	2006 Daily	2006 Cum	2007 Daily	2007 Cum	2008 Daily	2008 Cum	2010 Daily	2010 Cum
6-Aug										
7-Aug										
8-Aug	2,819	2,819	570	570	269	269	521	521	173	173
9-Aug	4,117	6,936	526	1,096	375	644	673	1,194	130	303
10-Aug	5,235	12,171	625	1,721	551	1,195	717	1,911	258	561
11-Aug	5,899	18,070	589	2,310	553	1,748	662	2,573	386	947
12-Aug	5,214	23,284	751	3,061	628	2,376	877	3,450	514	1,461
13-Aug	5,972	29,256	871	3,932	504	2,880	1,332	4,782	641	2,102
14-Aug	6,252	35,508	1,074	5,006	522	3,402	1,008	5,790	769	2,871
15-Aug	5,923	41,431	2,960	7,966	553	3,955	1,136	6,926	897	3,768
16-Aug	6,893	48,324	1,785	9,751	572	4,527	1,054	7,980	1,025	4,793
17-Aug	7,154	55,478	1,082	10,833	674	5,201	1,321	9,301	1,152	5,945
18-Aug	5,245	60,723	1,276	12,109	786	5,987	1,099	10,400	1,381	7,326
19-Aug	6,233	66,956	1,646	13,755	591	6,578	862	11,262	1,562	8,888
20-Aug	5,820	72,776	1,931	15,686	496	7,074	755	12,017	1,865	10,753
21-Aug	6,479	79,255	2,216	17,902	454	7,528	967	12,984	1,468	12,221
22-Aug	5,303	84,558	2,501	20,403	437	7,965	819	13,803	1,596	13,817
23-Aug	5,217	89,775	2,786	23,189	419	8,384	939	14,742	1,509	15,326
24-Aug	4,495	94,270	3,071	26,260	427	8,811	1,006	15,748	1,893	17,219
25-Aug	4,707	98,977	3,356	29,616	408	9,219	1,158	16,906	2,096	19,315
26-Aug	3,572	102,549	3,641	33,257	336	9,555	1,799	18,705	2,179	21,494
27-Aug	4,798	107,347	3,926	37,183	381	9,936	2,318	21,023	2,055	23,549
28-Aug	5,510	112,857	4,501	41,684	417	10,353	2,424	23,447	2,310	25,859
29-Aug	6,186	119,043	6,160	47,844	458	10,811	4,259	27,706	2,392	28,251
30-Aug	8,162	127,205	8,420	56,264	476	11,287	4,596	32,302	1,926	30,177
31-Aug	7,608	134,813	11,266	67,530	556	11,843	5,376	37,678	2,046	32,223
1-Sep	18,372	153,185	11,041	78,571	897	12,740	6,184	43,862	1,937	34,160
2-Sep	12,774	165,959	11,815	90,386	994	13,734	6,440	50,302	1,883	36,043
3-Sep	17,290	183,249	10,819	101,205	1,658	15,392	7,210	57,512	1,847	37,890
4-Sep	23,630	206,879	9,762	110,967	2,965	18,357	8,411	65,923	1,816	39,706
5-Sep	25,251	232,130	7,091	118,058	5,086	23,443	7,530	73,453	1,914	41,620
6-Sep	24,374	256,504	6,522	124,580	6,739	30,182	6,979	80,432	2,330	43,950
7-Sep	22,788	279,292	5,744	130,324	9,676	39,858	6,814	87,246	3,224	47,174
8-Sep	22,831	302,123	5,675	135,999	13,137	52,995	5,439	92,685	4,058	51,232
9-Sep	18,256	320,379	6,336	142,335	14,952	67,947	4,535	97,220	4,501	55,733
10-Sep	12,488	332,867	5,886	148,221	14,571	82,518	3,982	101,202	5,183	60,916
11-Sep	16,035	348,902	6,569	154,790	17,754	100,272	3,624	104,826	6,330	67,246
12-Sep	17,056	365,958	6,412	161,202	17,067	117,339	3,765	108,591	7,344	74,590
13-Sep	12,242	378,200	7,176	168,378	15,931	133,270	3,501	112,092	8,106	82,696
14-Sep	12,973	391,173	8,324	176,702	16,398	149,668	3,189	115,281	8,103	90,799
15-Sep	11,966	403,139	8,440	185,142	13,399	163,067	2,851	118,132	8,255	99,054
16-Sep	8,848	411,987	8,721	193,863	12,772	175,839	3,215	121,347	7,820	106,874
17-Sep	8,511	420,498	8,082	201,945	11,374	187,213	3,626	124,973	8,160	115,034
18-Sep	9,271	429,769	8,499	210,444	6,934	194,147	4,107	129,080	7,028	122,062
19-Sep	9,435	439,204	6,805	217,249	5,690	199,837	4,085	133,165	6,991	129,053
20-Sep	8,485	447,689	6,362	223,611	4,644	204,481	5,082	138,247	6,538	135,591
21-Sep	6,875	454,564	4,977	228,588	3,598	208,079	4,008	142,255	6,154	141,745
22-Sep	9,396	463,960	3,931	232,519	3,364	211,443	4,108	146,363	4,459	146,204
23-Sep	8,033	471,993	3,997	236,516	4,102	215,545	3,660	150,023	3,337	149,541
24-Sep	9,513	481,506	3,315	239,831	4,099	219,644	4,145	154,168	2,804	152,345
25-Sep	7,086	488,592	2,740	242,571	4,316	223,960	3,630	157,798	2,854	155,199
26-Sep	7,892	496,484	2,519	245,090	4,095	228,055	4,226	162,024	2,545	157,744
27-Sep										
28-Sep										
29-Sep										

Table A.4.1. — Continued.

Date	2011 Daily	2011 Cum	2012 Daily	2012 Cum	2013 Daily	2013 Cum	2014 Daily	2014 Cum	2015 Daily	2015 Cum
6-Aug							262	262		
7-Aug							222	484		
8-Aug			670	670	1,134	1,134	226	710	272	272
9-Aug	481	481	669	1,339	1,053	2,187	302	1,012	282	554
10-Aug	760	1,241	673	2,012	1,028	3,215	402	1,414	328	882
11-Aug	835	2,076	659	2,671	1,030	4,245	484	1,898	190	1,072
12-Aug	840	2,916	642	3,313	954	5,199	878	2,776	280	1,352
13-Aug	813	3,729	640	3,953	1,072	6,271	1,156	3,932	444	1,796
14-Aug	729	4,458	788	4,741	1,093	7,364	1,472	5,404	600	2,396
15-Aug	693	5,151	888	5,629	991	8,355	2,470	7,874	898	3,294
16-Aug	786	5,937	988	6,617	1,012	9,367	2,486	10,360	1,014	4,308
17-Aug	1,153	7,090	1,215	7,832	872	10,239	3,884	14,244	1,110	5,418
18-Aug	1,349	8,439	1,095	8,927	1,210	11,449	4,706	18,950	1,368	6,786
19-Aug	1,819	10,258	1,392	10,319	1,343	12,792	4,054	23,004	1,752	8,538
20-Aug	1,638	11,896	1,731	12,050	1,341	14,133	5,030	28,034	2,307	10,845
21-Aug	1,081	12,977	1,998	14,048	1,025	15,158	5,490	33,524	2,356	13,201
22-Aug	1,237	14,214	2,114	16,162	2,000	17,158	5,150	38,674	2,405	15,606
23-Aug	1,384	15,598	3,000	19,162	2,463	19,621	4,914	43,588	2,454	18,060
24-Aug	1,331	16,929	4,049	23,211	2,351	21,972	3,996	47,584	2,502	20,562
25-Aug	1,360	18,289	3,859	27,070	1,920	23,892	3,680	51,264	2,551	23,113
26-Aug	1,840	20,129	3,489	30,559	1,642	25,534	3,562	54,826	2,600	25,713
27-Aug	2,971	23,100	4,104	34,663	1,740	27,274	3,304	58,130	2,649	28,362
28-Aug	4,527	27,627	4,410	39,073	2,332	29,606	2,662	60,792	2,697	31,059
29-Aug	5,985	33,612	4,353	43,426	2,957	32,563	3,006	63,798	2,747	33,806
30-Aug	7,672	41,284	5,924	49,350	3,917	36,480	2,443	66,241	2,795	36,601
31-Aug	9,218	50,502	7,410	56,760	2,573	39,053	2,152	68,393	2,844	39,445
1-Sep	9,918	60,420	5,734	62,494	2,749	41,802	2,620	71,013	2,892	42,337
2-Sep	10,228	70,648	5,221	67,715	2,918	44,720	3,610	74,623	2,942	45,279
3-Sep	11,965	82,613	5,040	72,755	3,303	48,023	2,986	77,609	2,990	48,269
4-Sep	11,836	94,449	5,379	78,134	3,209	51,232	2,368	79,977	2,909	51,178
5-Sep	11,185	105,634	4,316	82,450	3,881	55,113	1,750	81,727	2,802	53,980
6-Sep	10,787	116,421	4,012	86,462	3,395	58,508	2,232	83,959	3,122	57,102
7-Sep	7,711	124,132	3,123	89,585	3,783	62,291	1,850	85,809	3,216	60,318
8-Sep	9,406	133,538	3,043	92,628	4,333	66,624	1,894	87,703	3,661	63,979
9-Sep	10,524	144,062	2,963	95,591	5,612	72,236	2,752	90,455	4,368	68,347
10-Sep	8,010	152,072	2,882	98,473	7,506	79,742	3,544	93,999	3,760	72,107
11-Sep	6,554	158,626	2,802	101,275	9,069	88,811	3,728	97,727	4,162	76,269
12-Sep	6,809	165,435	2,984	104,259	11,157	99,968	4,253	101,980	4,490	80,759
13-Sep	7,486	172,921	3,297	107,556	12,687	112,655	5,276	107,256	5,656	86,415
14-Sep	7,132	180,053	4,463	112,019	11,042	123,697	6,438	113,694	5,082	91,497
15-Sep	7,458	187,511	4,843	116,862	10,104	133,801	7,722	121,416	5,958	97,455
16-Sep	7,256	194,767	6,006	122,868	10,600	144,401	10,222	131,638	7,787	105,242
17-Sep	8,123	202,890	9,631	132,499	8,588	152,989	9,100	140,738	6,615	111,857
18-Sep	7,914	210,804	8,659	141,158	7,530	160,519	9,692	150,430	6,670	118,527
19-Sep	8,773	219,577	7,093	148,251	10,424	170,943	9,564	159,994	7,024	125,551
20-Sep	8,789	228,366	8,000	156,251	10,184	181,127	9,640	169,634	6,754	132,305
21-Sep	7,772	236,138	8,643	164,894	6,280	187,407	9,038	178,672	5,630	137,935
22-Sep	8,487	244,625	6,220	171,114	7,598	195,005	7,974	186,646	3,764	141,699
23-Sep	8,395	253,020	4,418	175,532	8,735	203,740	7,516	194,162	4,778	146,477
24-Sep	7,369	260,389	5,642	181,174	8,405	212,145	5,682	199,844	5,576	152,053
25-Sep	7,269	267,658	4,037	185,211	8,353	220,498	4,174	204,018	4,304	156,357
26-Sep	6,307	273,965	3,411	188,622	6,647	227,145	4,094	208,112	3,562	159,919
27-Sep			3,273	191,895			4,076	212,188	2,619	162,538
28-Sep			3,278	195,173			2,208	214,396		
29-Sep			2,758	197,931						

Table A.4.1. — Continued. (No data for 2020, when the project was suspended due to the COVID-19 pandemic.)

Date	2016 Daily	2016 Cum	2017 Daily	2017 Cum	2018 Daily	2018 Cum	2019 Daily	2019 Cum	2021 Daily	2021 Cum
6-Aug										
7-Aug										
8-Aug	443	443	1,706	1,706			331	331		
9-Aug	471	914	1,356	3,062			231	562		
10-Aug	538	1,452	987	4,049			204	766		
11-Aug	602	2,054	692	4,741			191	957		
12-Aug	481	2,535	594	5,335	291	291	126	1,083		
13-Aug	427	2,962	520	5,855	214	505	86	1,169		
14-Aug	649	3,611	642	6,497	220	725	148	1,317		
15-Aug	609	4,220	956	7,453	228	953	140	1,457		
16-Aug	832	5,052	1,485	8,938	270	1,223	160	1,617		
17-Aug	1,443	6,495	2,339	11,277	336	1,559	162	1,779		
18-Aug	1,776	8,271	2,462	13,739	458	2,017	194	1,973		
19-Aug	2,282	10,553	2,874	16,613	586	2,603	248	2,221		
20-Aug	3,147	13,700	2,942	19,555	728	3,331	308	2,529		
21-Aug	4,033	17,733	2,744	22,299	804	4,135	282	2,811		
22-Aug	4,608	22,341	2,920	25,219	558	4,693	250	3,061	68	68
23-Aug	4,856	27,197	3,735	28,954	614	5,307	469	3,530	188	256
24-Aug	5,839	33,036	3,866	32,820	450	5,757	318	3,848	177	433
25-Aug	5,544	38,580	4,000	36,820	745	6,502	398	4,246	138	571
26-Aug	4,752	43,332	4,821	41,641	634	7,136	566	4,812	129	700
27-Aug	5,424	48,756	5,650	47,291	834	7,970	718	5,530	139	839
28-Aug	5,293	54,049	6,738	54,029	646	8,616	648	6,178	142	981
29-Aug	5,066	59,115	6,230	60,259	806	9,422	540	6,718	157	1,138
30-Aug	4,824	63,939	5,998	66,257	546	9,968	564	7,282	308	1,446
31-Aug	4,906	68,845	6,191	72,448	622	10,590	508	7,790	545	1,991
1-Sep	4,973	73,818	6,384	78,831	604	11,194	571	8,361	478	2,469
2-Sep	5,063	78,881	6,576	85,408	688	11,882	919	9,280	655	3,124
3-Sep	4,526	83,407	6,769	92,177	1,064	12,946	1,232	10,512	737	3,861
4-Sep	4,545	87,952	6,268	98,445	1,422	14,368	2,158	12,670	651	4,512
5-Sep	4,740	92,692	5,764	104,209	1,632	16,000	3,166	15,836	772	5,284
6-Sep	4,403	97,095	5,328	109,537	2,618	18,618	4,194	20,030	699	5,983
7-Sep	3,258	100,353	5,592	115,129	1,930	20,548	4,688	24,718	620	6,603
8-Sep	2,929	103,282	7,216	122,345	2,742	23,290	4,046	28,764	668	7,271
9-Sep	3,045	106,327	10,330	132,675	3,826	27,116	4,576	33,340	758	8,029
10-Sep	3,082	109,409	12,012	144,687	3,622	30,738	4,116	37,456	832	8,861
11-Sep	3,167	112,576	16,642	161,329	4,576	35,314	3,798	41,254	627	9,488
12-Sep	3,622	116,198	20,334	181,663	4,298	39,612	3,470	44,724	615	10,103
13-Sep	3,247	119,445	23,388	205,051	3,940	43,552	3,904	48,628	853	10,956
14-Sep	3,387	122,832	31,542	236,593	5,174	48,726	3,438	52,066	625	11,581
15-Sep	4,198	127,030	34,214	270,807	5,820	54,546	3,998	56,064	528	12,109
16-Sep	5,750	132,780	33,240	304,047	6,010	60,556	4,220	60,284	685	12,794
17-Sep	8,299	141,079	27,584	331,631	6,492	67,048	4,674	64,958	579	13,373
18-Sep	11,136	152,215	25,838	357,469	7,058	74,106	3,952	68,910	684	14,057
19-Sep	11,528	163,743	24,064	381,533	6,586	80,692	4,226	73,136	726	14,783
20-Sep	12,737	176,480	20,886	402,419	7,646	88,338	4,056	77,192	707	15,490
21-Sep	13,311	189,791	21,042	423,461	8,188	96,526	4,323	81,515	653	16,143
22-Sep	14,449	204,240	18,942	442,403	7,678	104,204	3,756	85,271	535	16,678
23-Sep	14,106	218,346	13,469	455,872	7,084	111,288	3,820	89,091	621	17,299
24-Sep	12,033	230,379	11,380	467,252	6,124	117,412	3,694	92,785	580	17,879
25-Sep	11,413	241,792	8,421	475,673	6,728	124,140	4,020	96,805	541	18,420
26-Sep	12,603	254,395	8,160	483,833	6,496	130,636	3,854	100,659	526	18,946
27-Sep					6,970	137,606	3,430	104,089	708	19,654
28-Sep					5,614	143,220			292	19,946
29-Sep										

Table A.4.1. — Continued.

Date	2022 Daily	2022 Cum	2023 Daily	2023 Cum	2024 Daily	2024 Cum
6-Aug					439	439
7-Aug					313	752
8-Aug	39	39	129	129	236	988
9-Aug	54	93	112	241	226	1,214
10-Aug	69	162	148	389	128	1,342
11-Aug	84	246	120	509	135	1,477
12-Aug	99	345	175	684	117	1,595
13-Aug	114	459	190	874	97	1,691
14-Aug	183	642	291	1,165	149	1,841
15-Aug	209	851	324	1,489	117	1,958
16-Aug	187	1,038	394	1,883	170	2,128
17-Aug	190	1,228	642	2,525	168	2,296
18-Aug	228	1,456	659	3,184	153	2,449
19-Aug	336	1,792	586	3,770	187	2,636
20-Aug	362	2,154	480	4,250	167	2,803
21-Aug	363	2,517	501	4,751	236	3,039
22-Aug	441	2,958	837	5,588	216	3,255
23-Aug	520	3,478	830	6,418	278	3,532
24-Aug	598	4,076	715	7,133	380	3,913
25-Aug	676	4,752	673	7,806	388	4,301
26-Aug	647	5,399	634	8,440	323	4,624
27-Aug	692	6,091	719	9,159	414	5,038
28-Aug	754	6,845	703	9,862	365	5,403
29-Aug	756	7,601	1,070	10,932	437	5,840
30-Aug	723	8,324	1,438	12,370	510	6,350
31-Aug	764	9,088	1,805	14,175	518	6,869
1-Sep	611	9,699	2,172	16,347	608	7,477
2-Sep	652	10,351	2,539	18,886	556	8,032
3-Sep	865	11,216	2,907	21,793	838	8,870
4-Sep	1,120	12,336	3,274	25,067	1,195	10,065
5-Sep	1,255	13,591	3,444	28,511	1,312	11,377
6-Sep	1,602	15,193	3,830	32,341	2,081	13,457
7-Sep	1,571	16,764	4,253	36,594	2,521	15,979
8-Sep	2,092	18,856	4,672	41,266	1,770	17,749
9-Sep	2,494	21,350	5,631	46,897	1,706	19,454
10-Sep	2,706	24,056	6,416	53,313	1,648	21,102
11-Sep	2,941	26,997	6,824	60,137	1,928	23,030
12-Sep	3,177	30,174	6,733	66,870	1,697	24,727
13-Sep	3,412	33,586	5,573	72,443	2,011	26,738
14-Sep	3,646	37,232	7,590	80,033	1,924	28,662
15-Sep	3,274	40,506	7,260	87,293	1,902	30,564
16-Sep	3,010	43,516	6,772	94,065	1,400	31,963
17-Sep	2,798	46,314	5,216	99,281	1,634	33,598
18-Sep	2,634	48,948	4,256	103,537	1,735	35,333
19-Sep	2,302	51,250	3,292	106,829	1,905	37,237
20-Sep	2,354	53,604	2,723	109,552	1,809	39,047
21-Sep	2,194	55,798	3,763	113,315	2,181	41,227
22-Sep	1,834	57,632	3,147	116,462	2,215	43,442
23-Sep	1,642	59,274	3,058	119,520	2,108	45,550
24-Sep	1,399	60,673	2,936	122,456	2,153	47,704
25-Sep	1,294	61,967	3,070	125,526	1,913	49,616
26-Sep	1,128	63,095	3,218	128,744	1,817	51,433
27-Sep						
28-Sep						
29-Sep						

Table A.4.2. — Historical (1995–2024) estimates of quarter-point passage dates for fall Chum Salmon from sonar counts on the Teedriinjik River. Estimates for 2009 and 2020 are not available due to early termination of the project and the COVID-19 pandemic, respectively.

Year	First quarter	Midpoint	Third quarter
1995	28-Aug	7-Sep	14-Sep
1996	27-Aug	2-Sep	12-Sep
1997	31-Aug	6-Sep	10-Sep
1998	9-Sep	16-Sep	20-Sep
1999	25-Aug	3-Sep	10-Sep
2000	28-Aug	5-Sep	15-Sep
2001	23-Aug	3-Sep	11-Sep
2002	1-Sep	12-Sep	18-Sep
2003	27-Aug	3-Sep	12-Sep
2004	1-Sep	7-Sep	13-Sep
2005	30-Aug	6-Sep	13-Sep
2006	31-Aug	6-Sep	15-Sep
2007	9-Sep	12-Sep	16-Sep
2008	1-Sep	7-Sep	17-Sep
2009	–	–	–
2010	4-Sep	13-Sep	18-Sep
2011	2-Sep	10-Sep	18-Sep
2012	31-Aug	11-Sep	20-Sep
2013	6-Sep	14-Sep	19-Sep
2014	26-Aug	13-Sep	20-Sep
2015	1-Sep	13-Sep	19-Sep
2016	30-Aug	16-Sep	22-Sep
2017	8-Sep	15-Sep	19-Sep
2018	12-Sep	18-Sep	23-Sep
2019	8-Sep	14-Sep	21-Sep
2020	–	–	–
2021	5-Sep	12-Sep	20-Sep
2022	7-Sep	13-Sep	18-Sep
2023	6-Sep	12-Sep	17-Sep
2024	6-Sep	13-Sep	20-Sep
Average (1995–2024)	1-Sep	10-Sep	16-Sep
10-Yr. Average (2015–2024)	5-Sep	14-Sep	19-Sep
5-Yr. Average (2020–2024)	6-Sep	12-Sep	18-Sep