California Department of Fish and Wildlife
North Central Region

Lower American River Fall-run Chinook Salmon Escapement Survey October 2025 – January 2026

Presented to the United States
Bureau of Reclamation
By

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INTRODUCTION

The American River is the second-largest tributary to the Sacramento River and flows through a highly developed urban environment (Williams 2001). The lower American River (LAR) is a 23-mile stretch of the American River starting at the base of Nimbus Dam and extending downstream to the confluence with the Sacramento River at Discovery Park. The LAR supports both wild and hatchery fall-run Chinook salmon (FRCS, *Oncorhynchus tshawytscha*) spawning and rearing life stages. Historically, the LAR supported spawning of fall, spring, and late fall runs of Chinook salmon (Yoshiyama et al. 2000); spring-run Chinook was extirpated from the LAR following the construction of Folsom Dam in 1955. The fall-run represents the largest run of Chinook salmon found in California's Central Valley, although current FRCS populations are heavily supported by hatchery production (Yoshiyama et al. 2000). Adult FRCS are typically found in the LAR from September to January and generally begin to spawn in the LAR in early October, with the peak of the run occurring in late November to early December (Williams 2001).

The American River is heavily influenced by the presence of dams that limit salmon occurrence to the lowest 23 river miles. The Nimbus Fish Hatchery, constructed in 1958 to compensate for the loss of spawning and rearing habitat due to the construction of Nimbus Dam, releases approximately 4 million Chinook salmon annually (CDFW 2024). FRCS mark-recapture escapement surveys are performed to estimate spawner abundance and distribution, and have been conducted in the LAR since 1976, although escapement estimates of Central Valley salmon have been conducted since the 1940's and 1950's (Bergman et al. 2012). Data collected during escapement surveys are also used to examine life history traits, population age structure, pre-spawn mortality, the ratio of hatchery and natural origin FRCS on spawning grounds, and environmental effects on the population. Evaluation of stock-recruitment relationships from escapement survey data is used to aid in establishing harvest limits and fishing seasons. Because of environmental stochasticity and anthropogenic activity, salmon runs in California have exhibited a high degree of variation over time (Satterthwaite and Carlson 2015).

The primary objectives of the 2025-2026 escapement survey were to: 1) estimate the size of FRCS escapement in the LAR, 2) determine the ratio of adults to grilse, as well as the sex ratios of adults and grilse, 3) determine the degree of female pre-spawn mortality, and 4) collect coded-wire tags (CWT) to investigate the number and origin of hatchery-reared FRCS using spawning habitat in the LAR.

METHODS

Survey Sections

A 13.4-mile section of the lower American River, beginning at the Nimbus Dam and ending at the Watt Avenue bridge, was surveyed from October 14, 2025, to December 18, 2025. The survey area was divided into five sections (Figure 1, Table 1), each surveyed once over a 3-to-5-day survey period. Nimbus Basin (NB) is composed of a deep pool at the base of the dam, a riffle and run in the main channel, and two side channels composed of riffles, runs, and pools. In 2021, a rock channel was constructed as an entrance to a new fish ladder for the Nimbus Fish Hatchery. The rock channel entrance is in the upstream portion of NB and was included in the survey of NB during the 2025 survey. The location of the historic Nimbus Fish Hatchery weir structure separates NB from section 1 and is located adjacent to the Nimbus Fish Hatchery. Section 1 has continuously had the highest number of FRCS spawning activity and is composed primarily of riffles, glides, and a few deep pools. This section is split up into sections 1A and 1B for sampling purposes because of the high number of carcasses typically encountered. Section 2 contains a few riffles, but is composed primarily of large, deep-water glides. Section 3 consists of riffles, deep-water glides, and several stretches of braided side-channels. The LAR downstream of Watt Avenue has little spawning habitat and is primarily a migration corridor and, therefore, it is not included in the escapement survey.

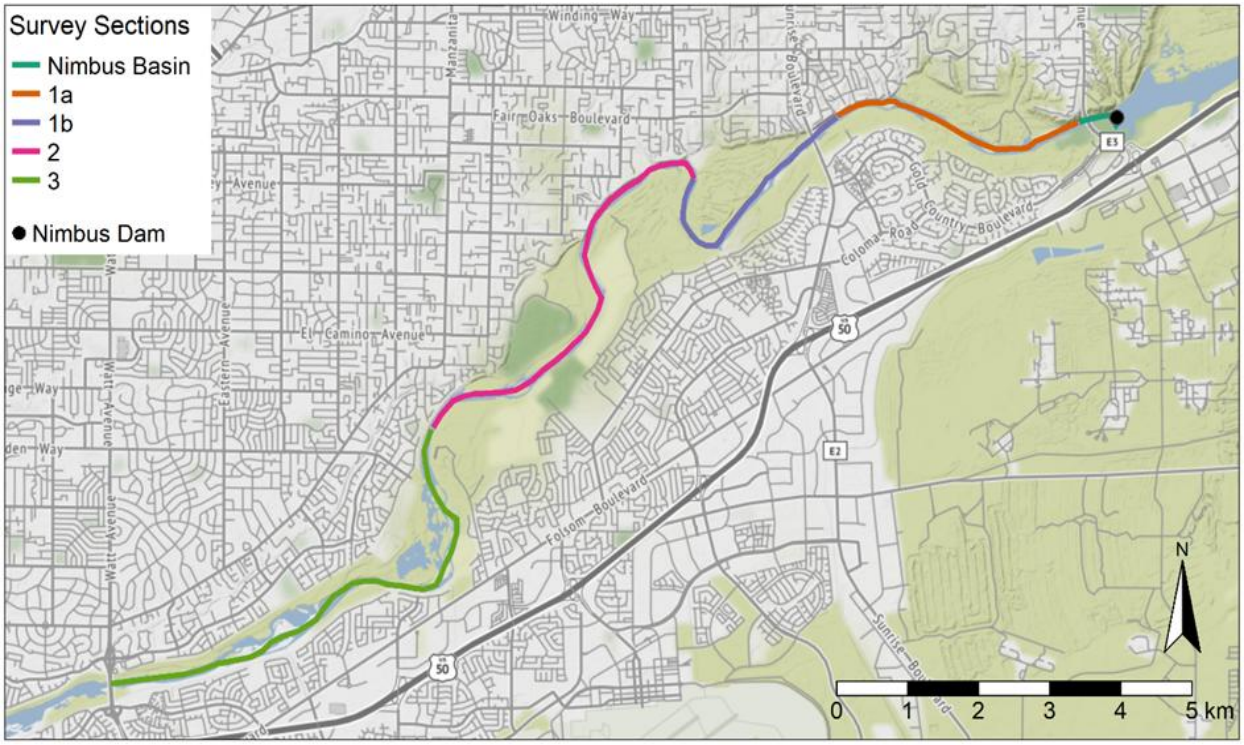

Figure 1. Survey sections for the lower American River Chinook salmon escapement survey.

Table 1. Survey section distances and descriptions of the FRCS escapement survey on the lower American River.

Section	Description	Miles
NB	Nimbus Dam to Nimbus Fish Hatchery Weir	0.3
1A	Nimbus Fish Hatchery Weir to Sunrise Blvd. River Access	2.6
1B	Sunrise Blvd River Access to El Manto Dr. River Access	1.7
2	El Manto Dr. River Access to River Bend Park River Access	4.7
3	River Bend Park Access to Watt Ave. River Access	4.1
	Total	13.4

Survey Logistics

Surveys were conducted by a crew consisting of 6-10 members searching for submerged salmon carcasses while walking the riverbanks, paddling kayaks, and/or operating a jet or drift boat. Nimbus Basin was surveyed only on foot from the banks, which is typical for this reach. Due to low flows and shallow river conditions occurring during most of the 2025 survey season, the use of a jetboat throughout the river was not possible. Instead, the jetboat was used opportunistically where conditions still permitted use. Section 1A was surveyed by jetboat, only in the approximately .3-mile reach downstream of the Sailor Bar boat ramp, as well as an approximately .7 mile stretch upstream of the Sunrise Blvd. bridge. Kayaks and walking crews were consistently used to survey the entirety of section 1A and 1B throughout all weeks of the survey. A drift boat was also utilized in section 1A and 1B during the first four weeks of the survey but ceased being used past that point due to mechanical issues. Section 2 was surveyed consistently by kayaks throughout all weeks of the survey. The jetboat was also used in section 2 during weeks 4-7, 9 and 10. Section 3 was surveyed by kayaks throughout the entire season.

Sub-sampling

All carcasses encountered during survey periods 1 through 5, and 9 through 10 were processed to the methods described below; however, systematic and unbiased subsampling was required during periods 6 through 8 due to the high number of carcasses encountered. During survey periods 6, 7, and 8, every other (1:2) carcass encountered was processed. Skipped carcasses were not disturbed and left to be part of the next weeks' sampling. The determination for subsampling was made at the start of each survey period and was based on the trend of total number of carcasses processed over the previous survey period. Once it was determined subsampling was necessary, this method was carried out for the entire survey period.

The 2025-2026 LAR FRCS escapement estimate was derived using a Cormack-Jolly-Seber (CJS) mark-recapture model for open populations (Cormack 1964, Bergman et al. 2012). Due to exceptionally high adult returns it was necessary for survey teams to subsample carcasses for

tagging and measurement. This required updating the CJS mark-recapture calculations to incorporate subsampling in the final escapement estimation.

Carcass Processing

Surveys began at the upstream boundary of each river section and progressed downstream, with crew members processing each carcass encountered, except during weeks 6-8, when high numbers of carcasses resulted in the need to implement sub-sampling one of every two (1:2) carcasses observed. Salmon carcasses ≤50% submerged were not included in the escapement survey, as these carcasses do not represent an equal probability of detection, and once dried require a longer time to decompose, which can skew mark-recapture analysis (Bergman et al. 2012). Each carcass was examined for the following: 1) presence of an external tag, 2) presence of an adipose fin, 3) extent of carcass degradation, and 4) extent of egg retention in females.

Carcasses were processed in one of three ways: 1) head collection for coded-wire tag (CWT) retrieval, 2) inclusion in the mark-recapture model, or 3) chopped in half and tallied. Heads were removed and retained from adipose fin clipped carcasses for CWT removal. Carcasses with an intact adipose fin were either included in the mark-recapture model or chopped and tallied. To be included in the mark-recapture model, a carcass must be in a fresh enough condition to be detected during subsequent survey periods; any carcasses not meeting these criteria were chopped in half to prevent inclusion in future surveys. The degree of carcass decomposition was determined by the examination of the eyes and gills. Carcasses were considered fresh if at least one eye was clear, or the gills were still red. Scale samples were collected from fresh carcasses by removing a one-inch square scale sample from the left side of the carcass above the lateral line and posterior to the dorsal fin. Carcasses were chopped and tallied if they were in an advanced state of decomposition (i.e., not fresh).

Carcasses included in the mark-recapture model were fitted with a hog ring and numbered disc tag on the left maxilla. Each tag was marked with colored flagging unique to the survey period and the tagged carcasses were deposited in the thalweg adjacent to the tagging location. The Covariate data was collected from all carcasses utilized in the mark-recapture model and from those destined for CWT retrieval. Covariate data included sex, fork length (FL), level of egg retention, and degree of decomposition. Sex was determined through a combination of characteristics including body morphology, presence or absence of a kype, and examination of gametes. If no gametes were present, sex was determined by examination of remaining internal reproductive organs. FL was measured from the tip of the snout to the fork of the caudal fin and rounded to the nearest centimeter. At the end of the survey season, fork lengths of fish with CWTs were pooled by sex and age and plotted in a frequency distribution. This was then compared to a similar frequency distribution of all fish that FL were collected from and used to

classify carcasses as grilse (a two-year old, sexually mature fish) or adults. The level of egg retention was determined by examining female carcasses, classifying each female as unspawned if >70% of eggs were present, partially spawned if 30-70% of eggs were retained, or spawned if <30% of eggs were retained.

During the 2025 LAR escapement survey, tissue samples were collected for the second consecutive year as part of the Parentage-Based Tagging (PBT) effort. Hatcheries began implementing PBT in a portion of the 2022 brood year fall-run Chinook Salmon as a less invasive tagging technique (CDFW 2023). As a result, fin clips were collected from unclipped, fresh carcasses of all sizes, to determine parentage from potential returning fish. Fin clips were collected from the least-decomposed fin (preferably the caudal fin but excluding the adipose fin) and placed on a piece of filter paper in an envelope. At the end of each field day, the samples were removed from their envelopes and laid out to dry as quickly as possible. Tissue samples will be analyzed post-season by CDFW's Central Valley Tissue Archive (CVA).

Water Temperature and Discharge Data

Water temperature and discharge data were obtained for each survey period from the United States Geological Survey gauge for the American River at Fair Oaks (Gauge ID 11446500) through the USGS website (USGS 2025). The Fair Oaks gauge is located at the upper end of section 1A approximately one hundred meters downstream of the historic weir structure. Daily average temperature and discharge recordings were selected to best measure changes in water temperature and flow through the duration of the study.

RESULTS

Survey Periods

The 2025 LAR survey consisted of 10 survey periods from October 14, 2024, to December 18, 2025. Nimbus Basin, section 1A, section 1B, and section 2 were surveyed during each survey period. Section 3 was not surveyed in weeks 5 and 7 due to inability to finish all sections due to a large increase in carcass counts (Table 2). Sub-sampling was implemented during weeks 6, 7, and 8 to effectively manage periods of high carcass counts. During this time, one of every two (1:2) carcasses observed was processed. Typically, LAR carcass surveys extend into early to mid-January; however, in 2025 the survey ended prematurely and abruptly during the third week of December due to a substantial increase in river flow which made conditions unsafe to proceed.

Table 2. Survey dates and sampling regime for the 2025-2026 lower American River Chinook salmon escapement survey.

Survey Period	Dates	Sections Not Surveyed	Sampling Regime Processed/Observed
1	Oct. 14 - 16	None	1:1
2	Oct. 20 - 23	None	1:1
3	Oct. 27 -30	None	1:1
4	Nov. 3, 4, 6, 7	None	1:1
5	Nov. 10 - 12, 14	3	1:1
6	Nov. 17 - 21	None	1:2
7	Nov. 22, 24 - 26	3	1:2
8	Dec. 1 - 5	None	1:2
9	Dec. 8 - 12	None	1:1
10	Dec. 15 - 18	None	1:1

Environmental Conditions

Daily average LAR temperatures generally decreased over the duration of the survey season. The highest average daily temperature recorded was 61.8F on October 21st, and the lowest average daily temperature was 52.7F on December 15th (Figure 2). Water temperature decreased to a level suitable for spawning on November 30th when the daily maximum water temperature recorded at Fair Oaks reached and remained below 56°F.

The US Bureau of Reclamation (USBR) initiated a power bypass of 66 cubic feet per second (cfs) on October 21st, 2025, to access the cold-water pool (CWP) at Folsom Dam for the purpose of providing suitable holding and spawning temperatures for FRCS. The bypass increased incrementally over a period of two days, averaging 264 cfs daily between October 23rd and October 26th, before increasing again on October 27th. The bypass averaged 492cfs between October 27th and November 6th, before decreasing over a period of two days to an average of 258 cfs between November 9th and November 20th, before reducing to 192 cfs on November 21st and 60 cfs on the final day (November 23rd).

Discharge was consistently low during the 10 weeks of the survey, with river flows ranging between 974 and 1,088 cfs (average 1,026 cfs) at the USGS American River Fair Oaks Guage (AFO) between October 14th and December 18th. On December 19th, the Bureau of Reclamation (USBR) initiated a change order at Nimbus Dam in response to a powerful atmospheric river

impacting the watershed, which resulted in a substantial increase in river flow (Figure 2). By December 21st, maximum flow recorded at the AFO gauge was 11,400 cfs. Flows remained high over the next several weeks, averaging 8,179 cfs between December 21st and January 16th. As a result, river conditions were deemed unsafe and ineffective for the crew to proceed, triggering an early end to the 2025 escapement survey, which concluded on December 18th.

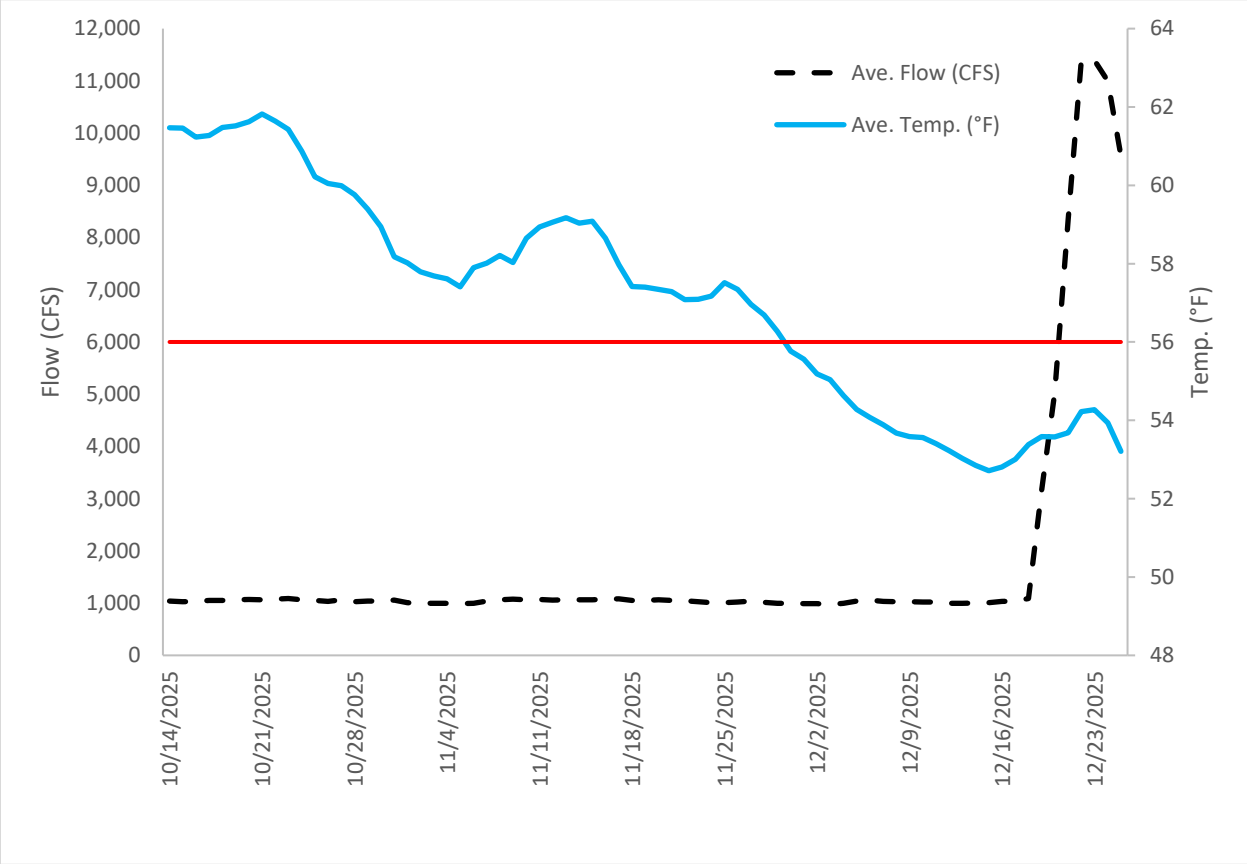

Figure 2. Daily average flow (left y-axis) and water temperatures (right y-axis) encountered during the 2025-2026 lower American River Chinook salmon escapement survey. Typically, LAR carcass surveys extend into early to mid-January; however, in 2025 the survey ended prematurely on December 18th due to a substantial increase in river flow. The red line indicates 56°F, which is considered the daily average temperature suitable for spawning and egg survival. Temperature and flow were reported by USGS, American River at Fair Oaks gauge (USGS 2025).

Final Carcass Count

During the 2025 lower American River escapement survey, 18,541 carcasses were observed and processed (Figure 3). The highest number of carcasses processed in a single survey period was 5,481 and occurred during survey period 9 (December 8 - 12). Of the 18,541 carcasses processed during the season, 1,431 fresh carcasses were encountered (Figure 4). Fresh carcasses were observed in all 10 survey periods, reaching a high of 445 fresh carcasses processed during sampling period 5 (November 10-14). While fresh fish counts were dropping after week 8, it was the increased flows due to flood control that ended the survey prematurely.

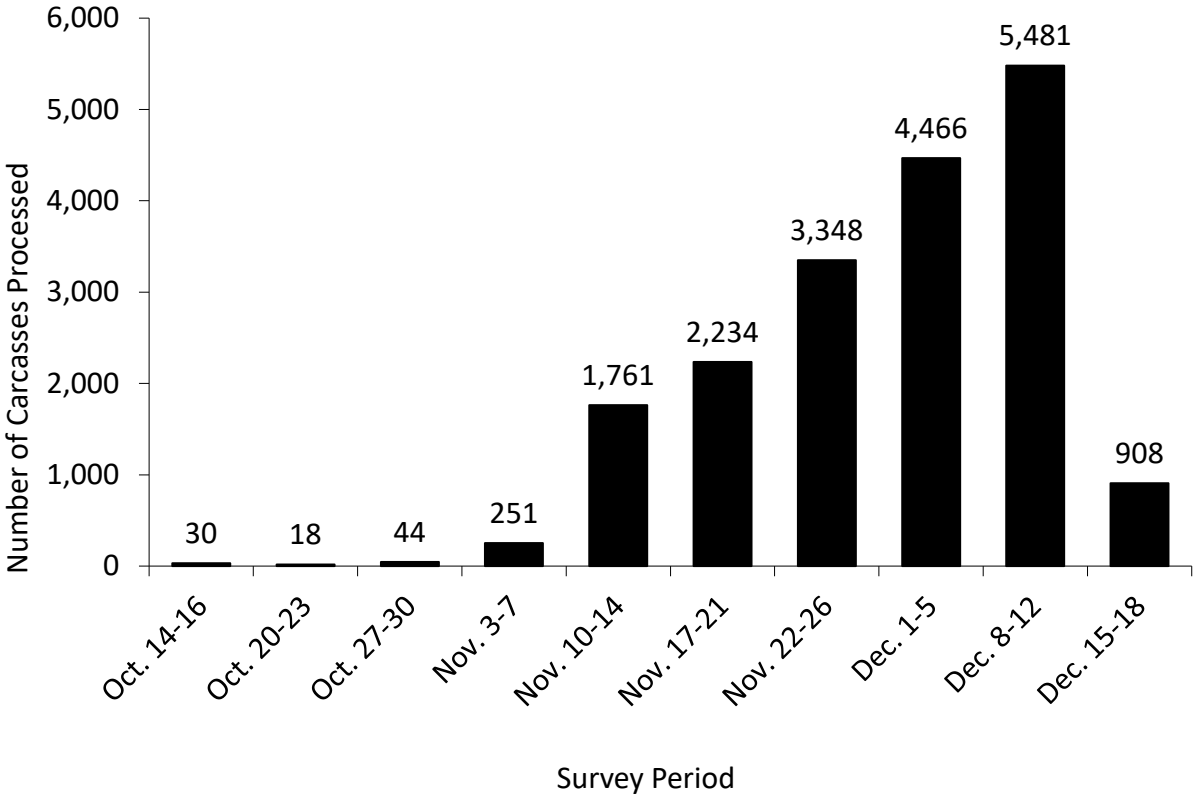

Figure 3. Numbers of carcasses observed and processed during the 2025-2026 lower American River Chinook salmon escapement survey.

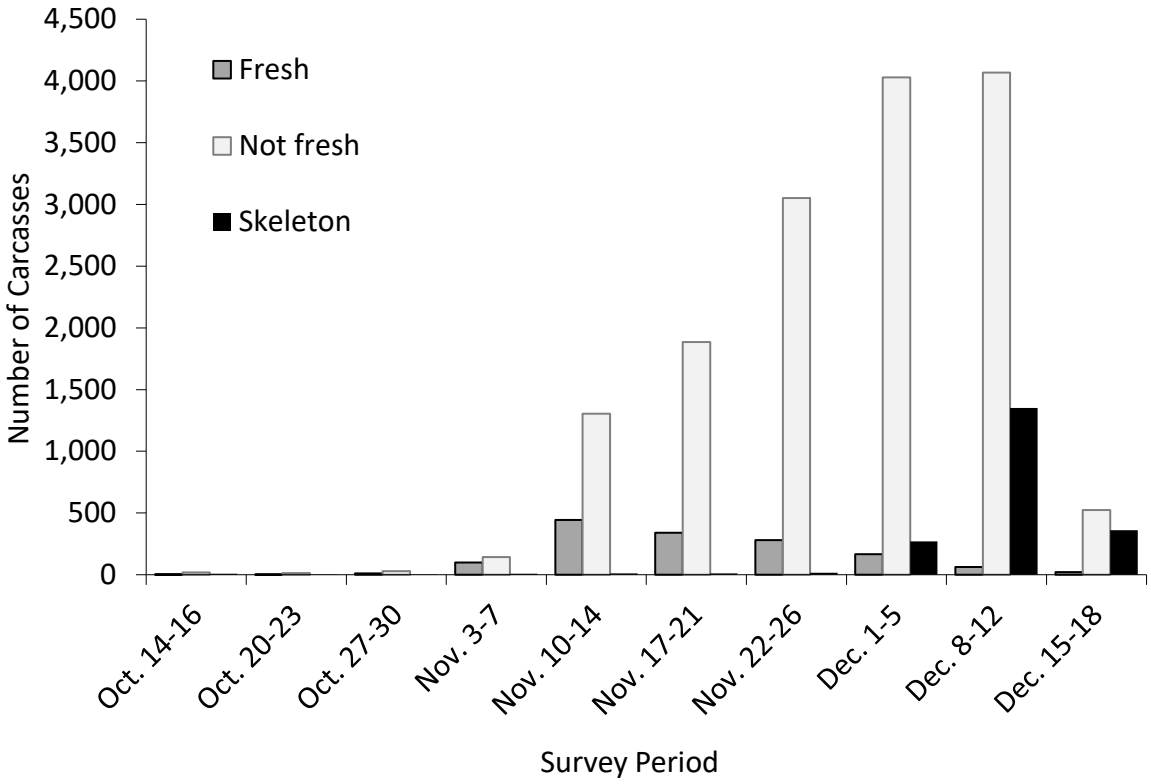

Figure 4. Number of fresh, not fresh, and skeleton carcasses processed in each survey period for the 2025-2026 lower American River Chinook salmon escapement survey.

Carcass Processing

Of the 18,541 carcasses processed, 16,334 (88.1%) were in an advanced stage of decomposition and were chopped and tallied. Of the remaining carcasses, 1,052 (5.7%) were processed for covariate data collection and chopped, which included 800 heads retained for CWT extraction, while 1,155 (6.2%) were disk-tagged and included in the mark-recapture study (Figure 5).

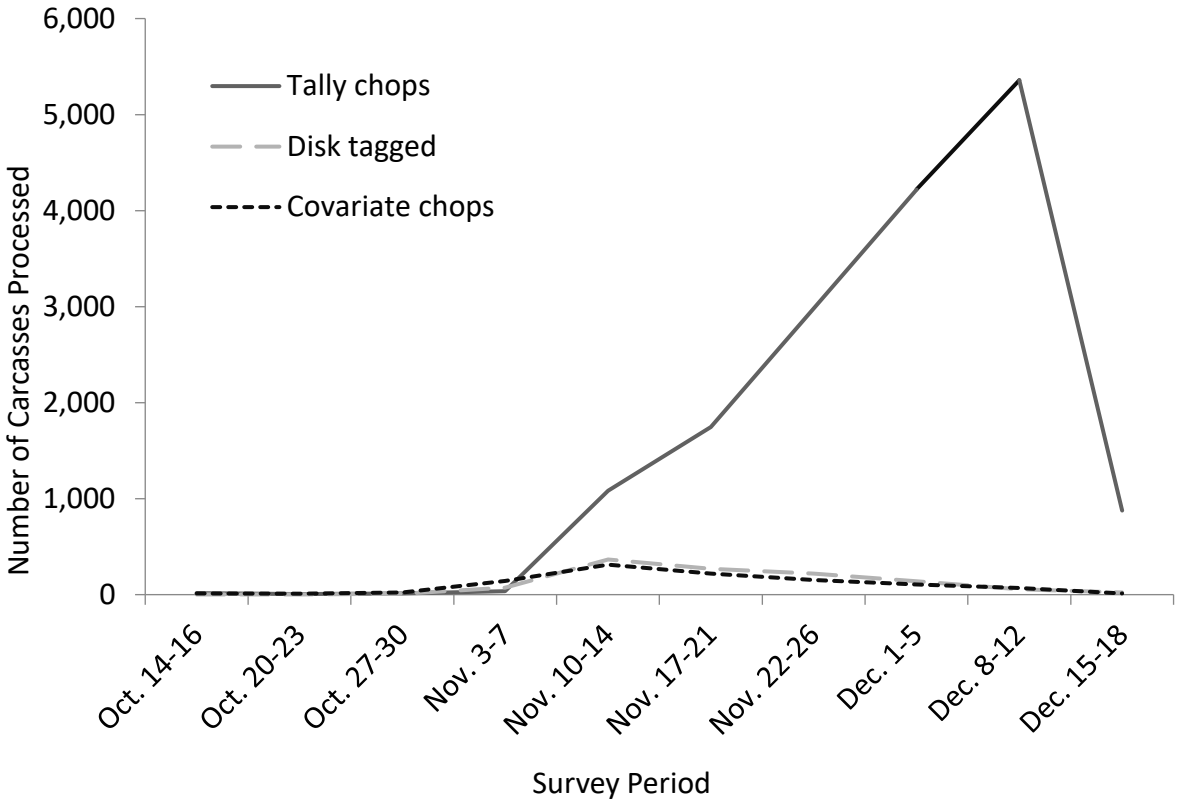

Figure 5. Frequency of processing method for carcasses collected during the 2025-2026 lower American River Chinook salmon escapement survey.

Spatial Distribution

Of the total number of carcasses processed during the survey, 5% were detected in NB (n = 914), 38% in section 1A (n = 7,043), 24% in section 1B (n = 4,487), 27% in section 2 (n = 4,992), and 6% in section 3 (n = 1105) (Figure 6, Table 3).

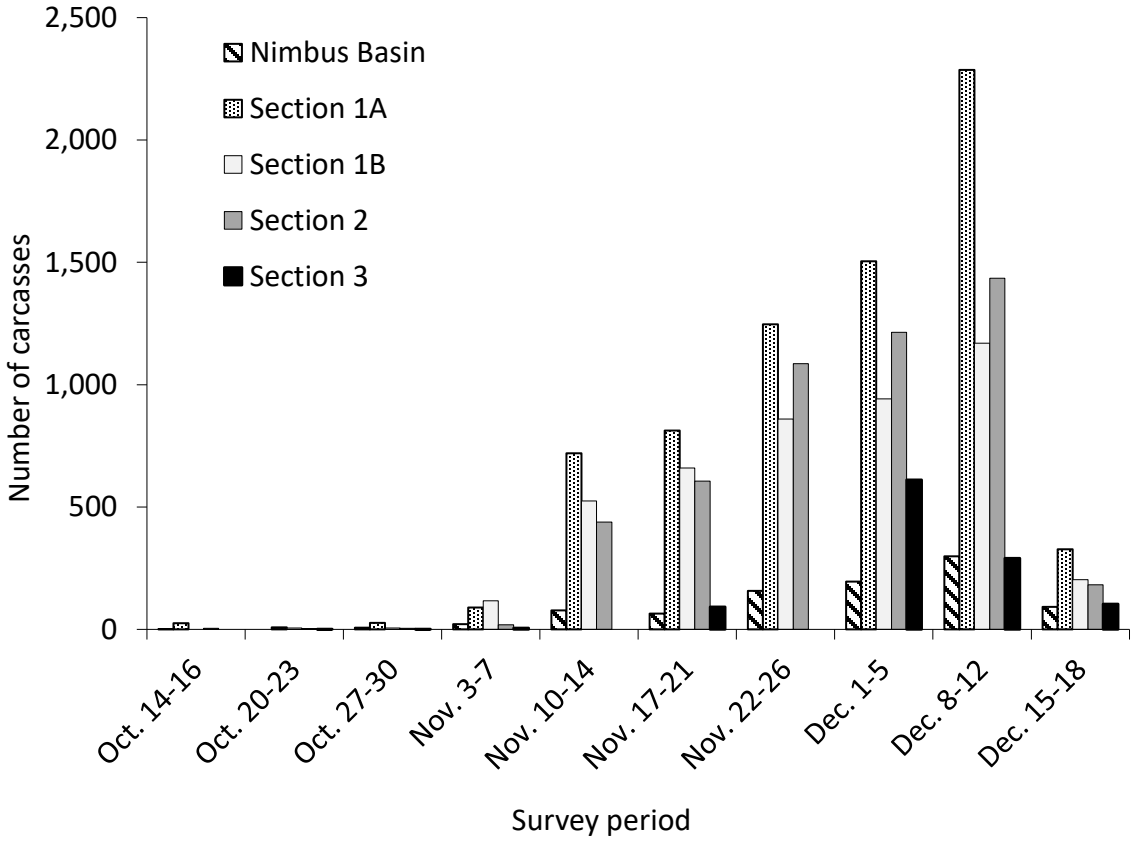

Figure 6. Spatial distribution of carcasses by survey period for the 2025-2026 lower American River Chinook salmon escapement survey.

Table 3. Spatial distribution of carcasses processed by survey period during the 2025-2026 lower American River Chinook salmon escapement survey.

Survey Period	Date	Nimbus Basin	Section 1A	Section 1B	Section 2	Section 3	Total
1	Oct. 14 to Oct. 16	1	25	0	4	0	30
2	Oct. 20 to Oct. 23	0	8	6	3	1	18
3	Oct. 27 to Oct. 30	7	26	6	4	1	44
4	Nov. 3 to Nov. 7	21	89	117	19	5	251
5	Nov. 10 to Nov. 14	78	719	525	439	NS	1,761
6	Nov. 17 to Nov. 21	64	813	659	606	92	2,234
7	Nov. 22 to Nov. 26	157	1,246	859	1,086	NS	3,348
8	Dec. 1 to Dec. 5	195	1,504	942	1,214	611	4,466
9	Dec. 8 to Dec. 12	299	2,286	1,170	1,435	291	5,481
10	Dec. 15 to Dec. 18	92	327	203	182	104	908
Total		914	7,043	4,487	4,992	1,105	18,541
Total (%)		5	38	24	27	6	

Sex Ratios

Sex data were recorded for 2,206 carcasses. Females represented 40% (n = 883) of the carcasses and males represented 60% (n = 1,323). Sex could not be determined for the remaining 16,335 carcasses because the gonads were too deteriorated. Males were found more frequently than females during every week of the survey except week 2 (Figure 7).

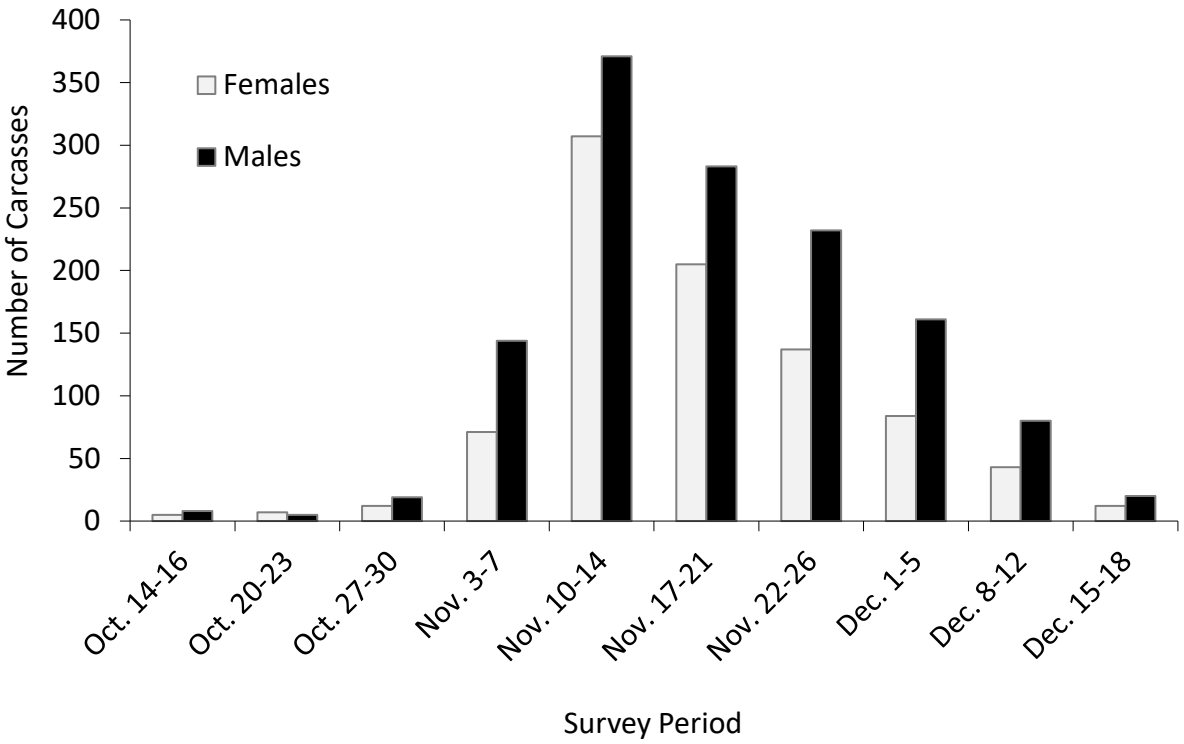

Figure 7. Number of male and female carcasses by survey period processed during the 2025-2026 lower American River Chinook salmon escapement survey.

Length Distributions

Fork length was recorded for 2,202 carcasses of known sex (Figure 8). The average length for females (n = 882) was 77 cm with a range of 50 cm to 98 cm. The average length for males (n = 1,320) was 75 cm with a range of 45 cm to 113 cm. There was one carcass of unknown sex with a length of 62cm.

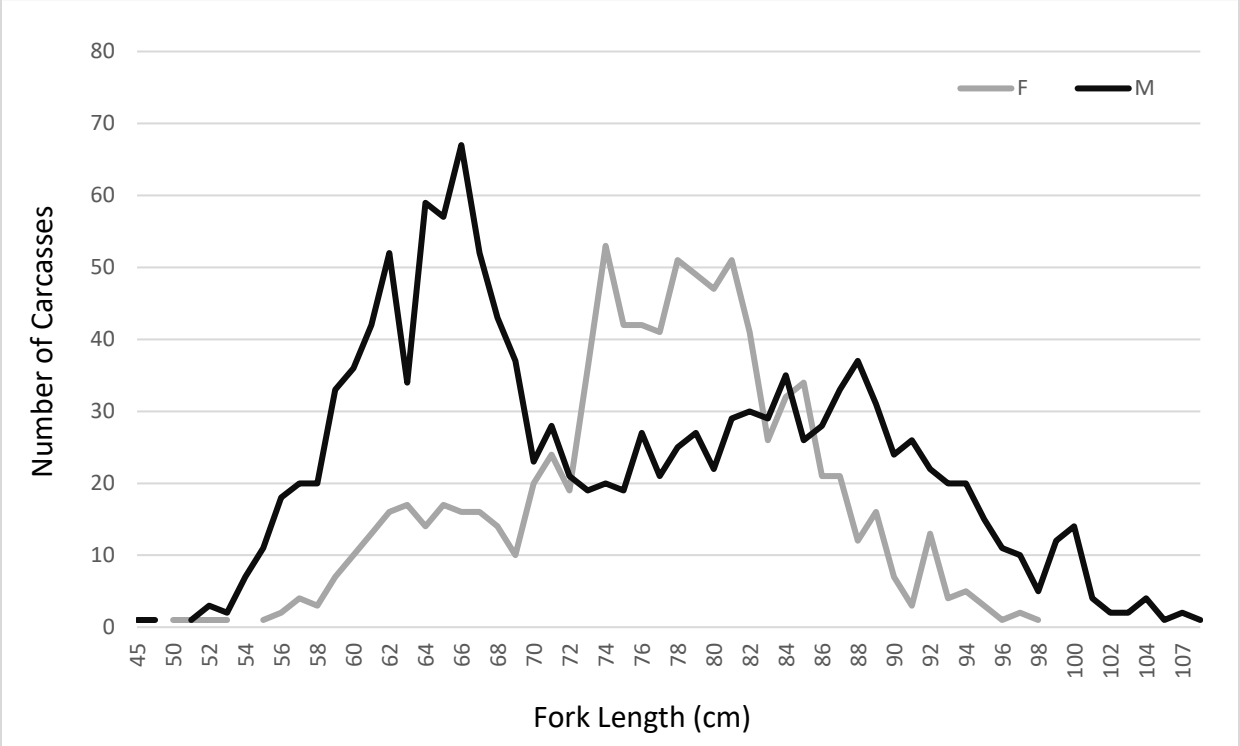

Figure 8. Fork length frequency distribution by sex for carcasses processed during the 2025-2026 lower American River Chinook salmon escapement survey.

Age Classification

Length-frequency distributions of known-age CWT carcasses were used to determine the size boundaries for adult and grilse carcasses for each sex (Figures 9 and 10). Fish were classified as adults (≥3 years-old) if females had a FL ≥ 67 cm and males had a FL ≥ 72 cm. Fish were classified as grilse (≤2 years-old) if females had a FL of ≤66 cm and males had a FL of ≤71 cm.

A total of 1,431 (65%) carcasses were classified as adult, and 772 (35%) carcasses were classified as grilse. The adult age class consisted of 758 (53%) females, and 673 (47%) males. The grilse age class consisted of 124 (16%) females, 647 (84%) males, and 1 (<1%) grilse of unknown sex (Figure 11). The number of grilse peaked in week 6, and the number of adults peaked in week 5 (Table 4).

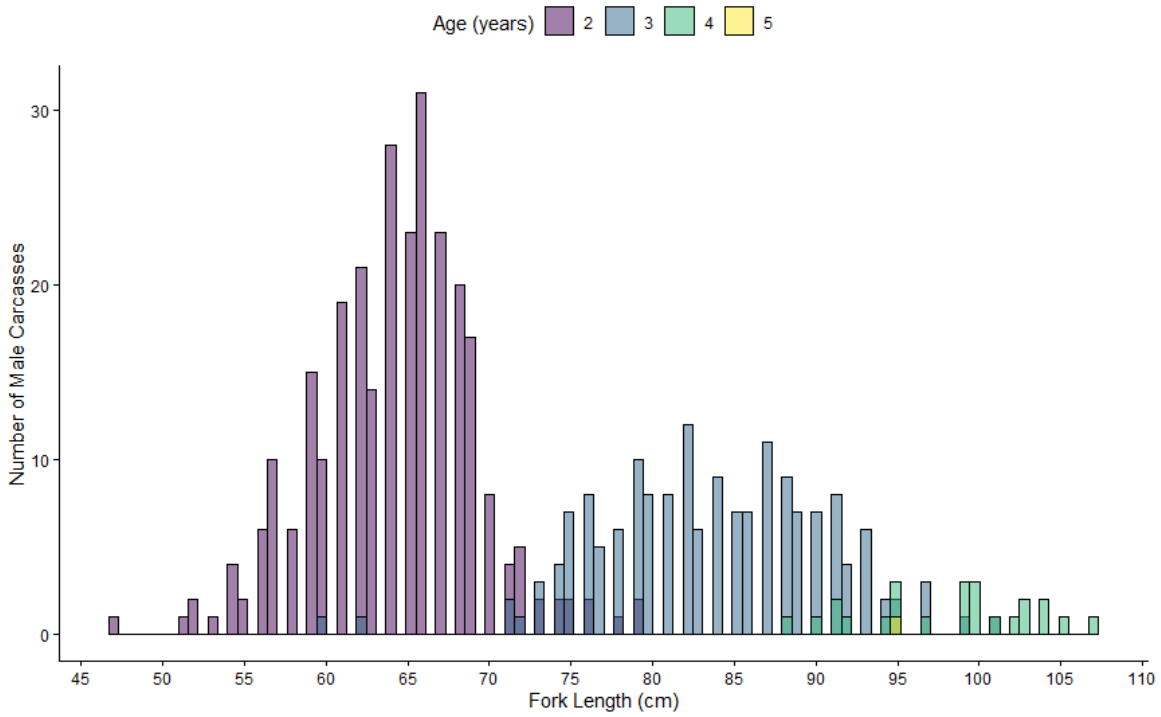

Figure 9. Fork length frequency distribution of known-age coded wire tagged male carcasses processed during the 2025-2026 lower American River Chinook salmon escapement survey.

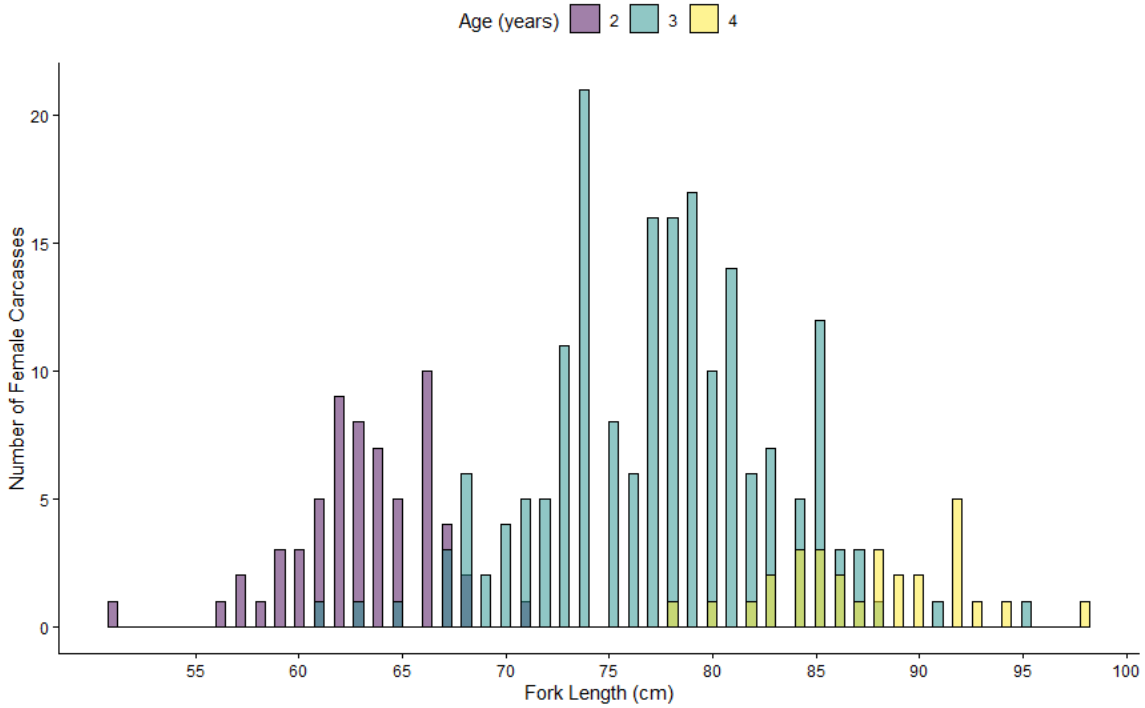

Figure 10. Fork length frequency distribution of known-age coded wire tagged female carcasses processed during the 2025-2026 lower American River Chinook salmon escapement survey.

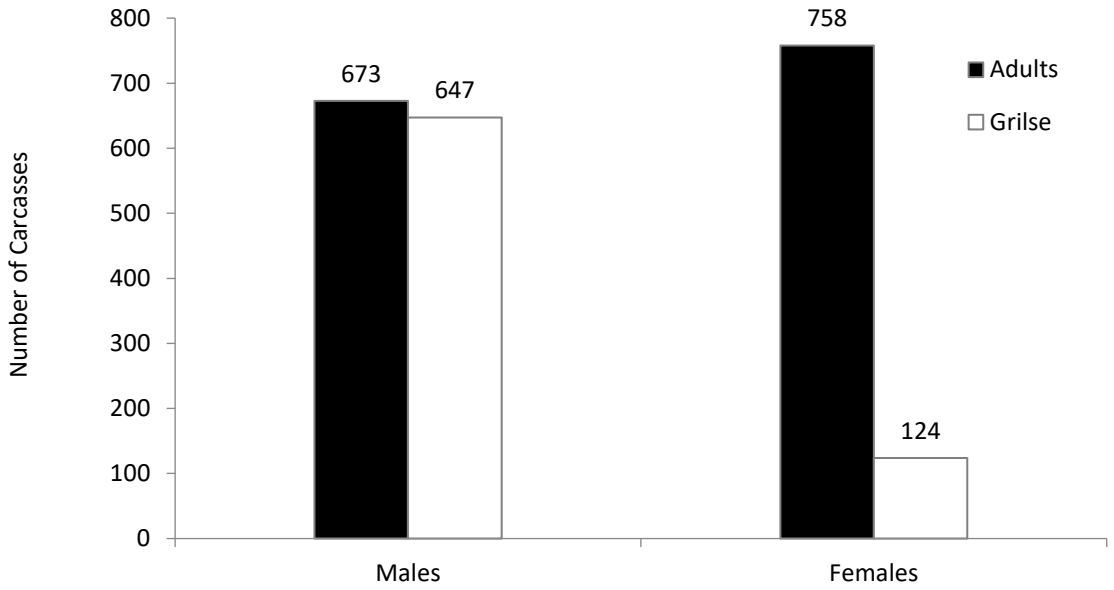

Figure 11. Number of male and female carcasses assigned to adult or grilse age classes during the 2025-2026 lower American River Chinook salmon escapement survey.

Table 4. Summary of processed salmon carcasses by age class during the 2025-2026 lower American River Chinook salmon escapement survey.

Survey Period	Date	Grilse		Adult	
		n	%	n	%
1	Oct. 14-16	0	0	11	100
2	Oct. 20-23	0	0	12	100
3	Oct. 27-30	4	13	27	87
4	Nov. 3-7	47	22	168	78
5	Nov. 10-14	195	29	482	71
6	Nov. 17-21	201	41	287	59
7	Nov. 22-26	161	44	207	56
8	Dec. 1-5	109	44	137	56
9	Dec. 8-12	45	37	78	63
10	Dec. 15-18	10	31	22	69
	Total	772		1,431	
	Total (%)	35		65	

Pre-spawn Mortality

Degree of egg retention was determined for 821 female carcasses (Table 5). Spawned females accounted for 70% (n = 571), partially spawned accounted for 14% (n = 116), and unspawned accounted for 16% (n = 134) of examined female carcasses. The proportion of spawned females varied throughout the survey period. Through the first 2 weeks of the survey, most females assessed for egg retention were either unspawned or partially spawned; however, for the rest of the survey the majority of females were spawned (Figure 12).

Table 5. Egg retention status of female carcasses and mean water temperature by survey period during the 2025-2026 lower American River Chinook salmon escapement survey. Unspawned females retained >70% of eggs, partially spawned females retained 30-70% of eggs and spawned females retained <30% of eggs. Water temperature data were reported by USGS, American River at Fair Oaks gauge (USGS 2025).

Survey Dates	Survey Week	Mean Water Temperature °F	Unspawned Females		Partially Spawned Females		Spawned Females		Total
			n	%	n	%	n	%	
Oct 14 - 16	1	61.4	3	75	1	25	0	0	4
Oct 20 - 23	2	61.5	6	86	0	0	1	14	7
Oct 27 - 30	3	59.5	3	27	2	18	6	55	11
Nov. 3 - 7	4	57.7	13	19	20	29	35	51	68
Nov. 10 - 14	5	59.0	24	8	39	13	237	79	300
Nov. 17 - 21	6	57.5	38	20	21	11	128	68	187
Nov. 22 - 26	7	57.2	25	19	25	19	80	62	130
Dec. 1 - 5	8	54.9	22	31	8	11	42	58	72
Dec. 8 - 12	9	53.5	0	0	0	0	32	100	32
Dec. 15 - 18	10	53.0	0	0	0	0	10	100	10
Total			134	**16**	116	**14**	571	**70**	821

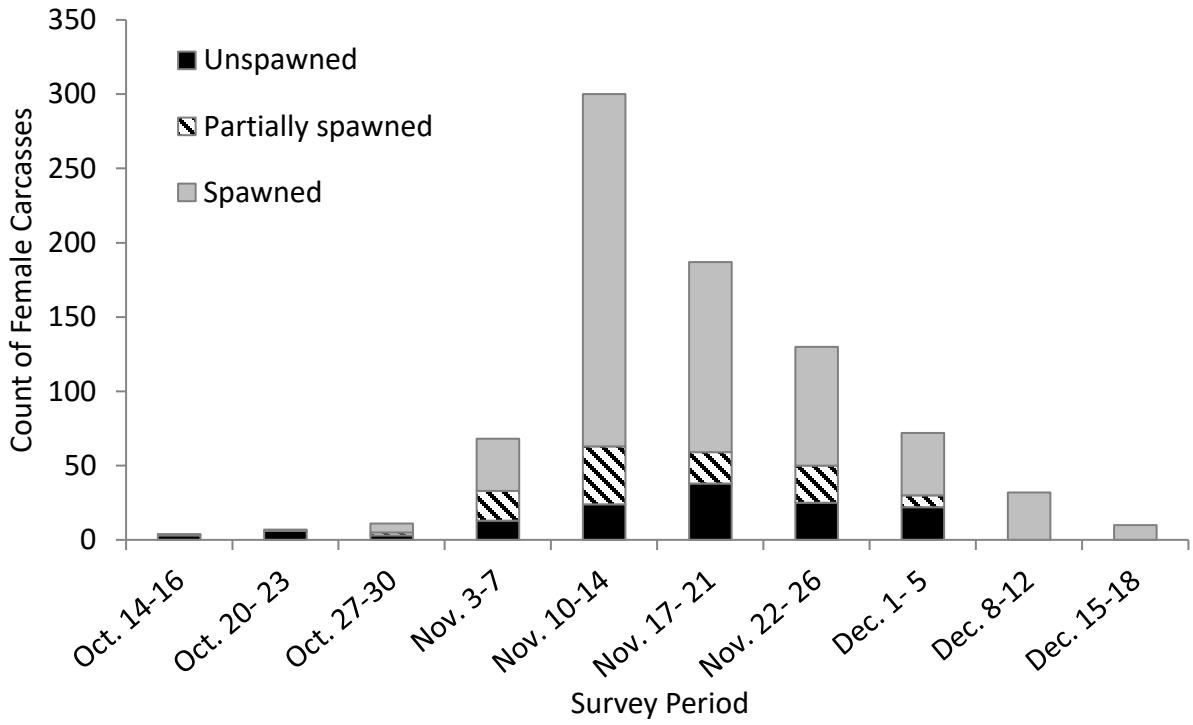

Figure 12. Egg retention status of female carcasses per survey period for the 2025-2026 lower American River Chinook salmon escapement survey.

CWT Carcasses

Hatcheries in the Central Valley generally tag approximately 25% of hatchery-reared FRCS with CWT's and mark these fish by clipping their adipose fin. All Chinook salmon carcasses were inspected for the presence or absence of an adipose fin. Adipose fin-clipped carcasses were recovered during all weeks of the survey (Table 6, Figure 13). A total of 2,891 (15.6%) carcasses had an adipose fin clip, which is lower than the rate observed from fish that entered the Nimbus Fish Hatchery (20.8%). Of those adipose fin-clipped fish, heads were collected from 800 for CWT recovery. Adipose fins were intact for 13,171 (71%) of carcasses and presence or absence could not be determined for 2,479 (13%) of carcasses.

The staff at the CDFW Central Valley Salmonid Archive processed 800 carcass heads for CWT extraction. Of these, 93.3% (n= 746) were fall-run, 0.8% (n= 6) were spring-run from San Joaquin Hatchery, and the remaining 6.0% (n= 48) either had no CWT, the CWT was unreadable, or the CWT was lost during extraction. Of the 746 FRCS, 76.8% (n= 573) originated from Nimbus Fish Hatchery, 16.4% (n= 122) from Mokelumne River Hatchery, 5.0% (n= 37) from Coleman National Fish Hatchery, 0.7% (n= 5) from Feather River Hatchery, 1.2% (n= 9) from Merced River Fish Facility. Approximately 23.3% (173 of 746) of CWT FRCS originated from hatcheries outside of the American River watershed.

Table 6. Adipose condition of carcasses by survey period for the 2025-2026 lower American River escapement survey.

Survey Period	Date	Adipose Intact	Adipose Clipped	Skeleton/Unknown	Total
1	Oct. 14-16	17	6	7	30
2	Oct. 20-23	12	4	2	18
3	Oct. 27 -30	36	4	4	44
4	Nov. 3-7	199	44	8	251
5	Nov. 10-14	1,507	238	16	1,761
6	Nov. 17-21	1,908	311	15	2,234
7	Nov. 22-26	2,612	714	22	3,348
8	Dec. 1-5	3,317	801	348	4,466
9	Dec. 8-12	3,165	679	1,637	5,481
10	Dec. 15-18	398	90	420	908
	Total	13,171	2,891	2,479	18,541
	Total (%)	71%	16%	13%	

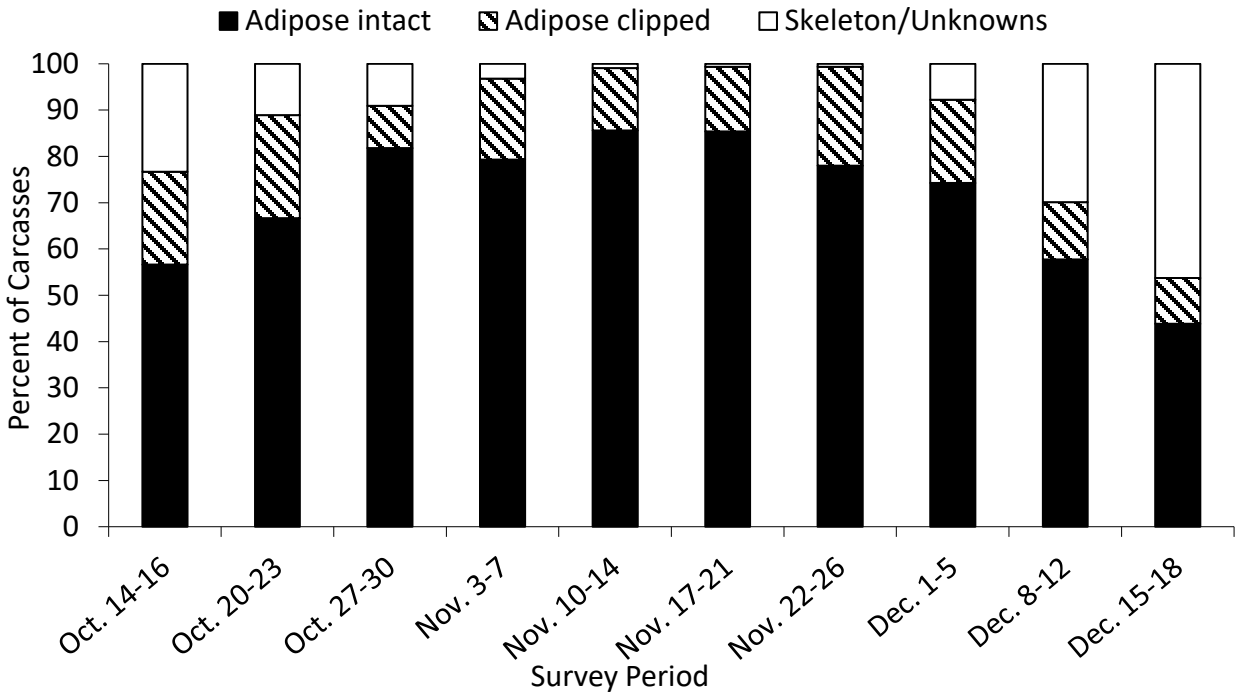

Figure 13. Temporal distribution of adipose fin condition for carcasses processed 2025-2026 lower American River escapement survey.

Escapement Estimate

To calculate an escapement estimate, 1,155 fresh carcasses were marked with uniquely numbered disk tags for inclusion in the CJS population model. Of the tagged carcasses, 259 carcasses (22%) were recaptured at least once, with 269 recapture events in total. The LAR escapement estimate for 2025 was 63,308 FRCS (95% CI = 55,851 to 73,412). This estimate was calculated using 1,000 bootstraps. The total escapement estimate was multiplied by the fraction of adults and grilse (approximately 65% and 35%, respectively) to obtain an escapement estimate of 42,123 and 22,185 for adults and grilse, respectively. In addition to the in-river escapement, 14,334 Chinook entered Nimbus Fish Hatchery via the fish ladder. Of those, length and sex were recorded for 14,167 FRCS (5,751 adults and 8,416 grilse). The hatchery uses a static length boundary of 68.5 cm to assign an age class for both sexes.

DISCUSSION

Salmon Fishery Closure and 2025's Escapement Estimate

In 2025, Salmon stocks continued to be impacted in California from ongoing issues associated with drought and climate disruption. Salmon returning to California's coast and rivers were impacted by a multi-year drought, severe wildfires and associated impacts to spawning and rearing habitat, harmful algal blooms and ocean forage shifts (CDFW 2025). The low ocean abundance forecasts, coupled with low returns in previous years, led the Pacific Fishery Management Council (PFMC) to recommend full closure of California's commercial salmon fisheries (CDFW 2025) for the third consecutive year. However, for the first time since 2022, a short recreational salmon season was allowed.

Various factors influence annual LAR escapement estimates, including escapement and spawning success of previous brood years, juvenile survival during emigration, ocean conditions, predation and harvest of adults, and river conditions (e.g., flow and water temperature). The 2025 LAR escapement estimate (63,308 FRCS) is an increase as compared to the previous year (45,541 FRCS) (Figure 14) and was likely positively impacted by the commercial salmon fishery closure and limited recreational fishery. The majority of salmon that returned to the LAR in 2025 were expected to be from brood year 2022 which had a reported escapement estimate of 16,383 FRCS.

Peak carcass recovery occurred during survey period 9 (December 8-12), which is consistent with the historical average for LAR FRCS. Spawn timing of Chinook salmon is associated with environmental conditions, and higher water temperatures are correlated with later spawning (Quinn et. Al. 2002; Carter 2005; Goniea et. Al 2006) and higher pre-spawn mortality (Carter

2005). Climate driven variations in temperature are of increasing relevance for the Central Valley population of FRCS, which spawn at the southern extent of the species' range, therefore making it more susceptible to climate change (Williams 2006). Maintenance of the cold-water pool (CWP) behind Folsom Dam and cold-water releases have become increasingly relevant for survival of LAR FRCS stocks (Yates et al. 2008).

Since 2011, cutoff lengths between grilse and adult age classes have ranged between 68 cm and 76 cm FL for males, and between 60 cm and 70 cm FL for females (Figure 15). In 2025, cutoff lengths occurred within this range for both sexes, 72 cm for adult males and 67 cm for adult females. The adults to grilse ratio in 2025 is within the range exhibited in prior surveys; however, is on the lower end with 65% adults observed as compared to 35% grilse (Figure 16). Chinook salmon have been known to exhibit density dependent reproductive success, with larger fish often being most successful resulting in population level size selection (Roni and Quinn 1995).

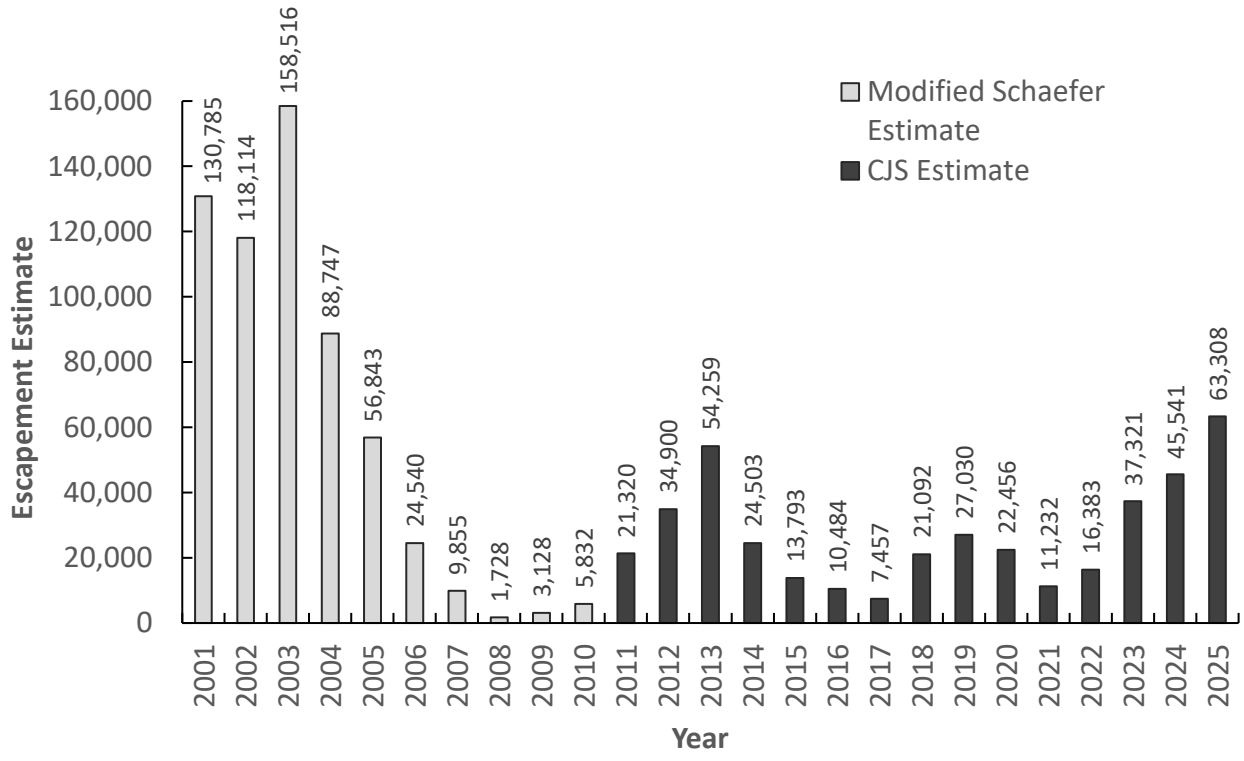

Figure 14. Historical in-river escapement estimates for the lower American River from 2001-2025.

Figure 15. Minimum fork lengths for adult Chinook salmon of both sexes observed from 2011-2025 during the lower American River escapement survey.

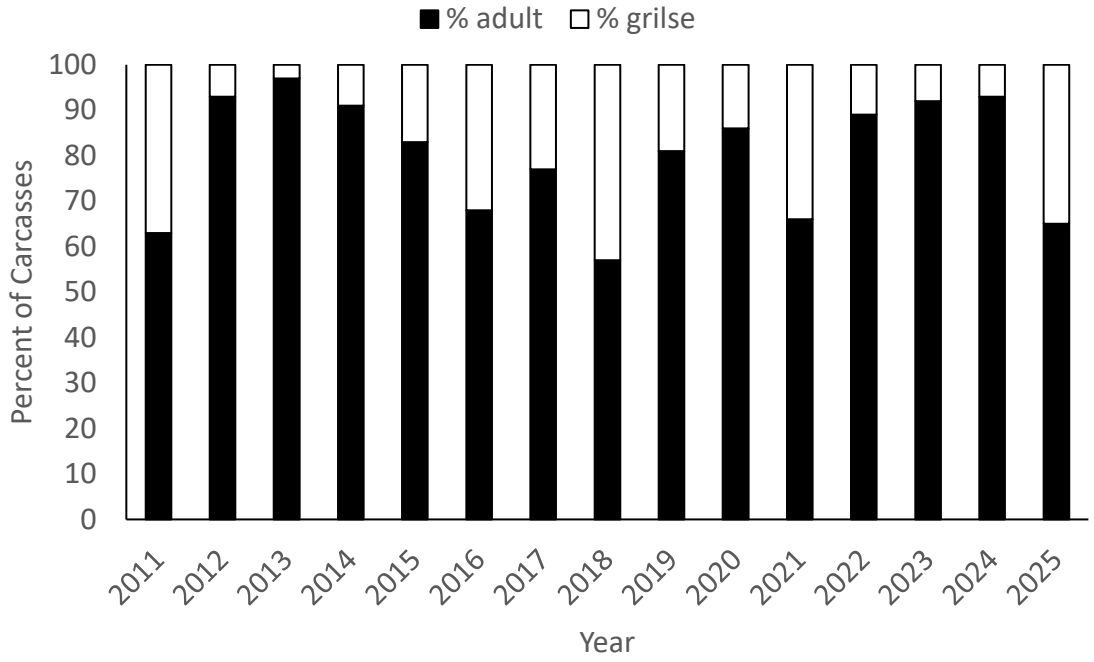

Figure 16. Proportion of adult and grilse carcasses observed each year from 2011 to 2025 during the lower American River escapement survey.

Nimbus Fish Hatchery Releases and CWT Returns

There were six LAR 2022 brood year FRCS smolt releases in May and June 2023, resulting in a total of 4,651,463 juvenile chinook salmon released (PSMFC, 2023). Of the fish released, 25% (1,156,294) were coded wire tagged and marked with an adipose fin clip. Preliminary CWT data indicates the overall proportion of fish that strayed to the LAR in 2025 increased, with 76% of returning adults originating from Nimbus Fish Hatchery, compared to 83% the previous year. Mokelumne Fish Hatchery comprised the majority of fish that strayed to the LAR (n = 122, 16%). The proportion of fish from Mokelumne Fish Hatchery increased from 13% in 2024, to 16% in 2025. Juvenile release location has a strong correlation with return and stray rates and can dramatically influence salmon survival rates (Palmer-Zwahlen and Kormos 2012).

Thiamine Deficiency

Returning adult Chinook salmon that fed off the coast of central California may have been susceptible to a deficiency of thiamine (vitamin B1). Previous studies have shown there was a high abundance of anchovy off the coast of central California in recent years. Anchovies produce an enzyme called thiaminase which breaks down thiamine, an essential vitamin that supports metabolic function. Thiamine deficiency in returning adult salmon can impact prespawn mortality and juvenile survival and is currently being investigated by researchers (Mantua et al. 2021) Central Valley hatcheries have been successful in treating hatchery produced salmon for thiamine deficiency but the sub-lethal effects and impacts this may have on in-river juvenile production is still being investigated.

River Flows

River flows were consistently low throughout the 10 weeks of the survey, averaging only 1,026cfs. Lower river flows appeared to result in a reduction of spawning habitat as compared to the prior two seasons, including a reduction of side channel habitat in some areas where restoration work had previously been performed. Low flow periods may intensify competition for spawning habitat, especially during higher return years, resulting in redd superimposition which occurs when females dig their nests on top of ones made previously by other spawning salmon. This in turn reduces the overall spawning success of the run, due to lower survivability rates of embryos.

Lower flows this year may have increased the carcass observation rate relative to the true number of carcasses present. Under these low-flow conditions, survey crews may have been able to detect and access carcasses more effectively than during seasons with higher streamflow.

During the third week of December, flows ramped up significantly reaching 11,400cfs by December 21st. At this time, adults were still actively spawning in the river. Salmon eggs and alevin are vulnerable to substrate movement and the scouring of redds, which can occur during periods of high flow. Surveys were discontinued due to safety issues for the crew at the higher flows.

Escapement Estimate as Compared to CVPIA's Doubling Goal

The Central Valley Project Improvement Act (CVPIA) established the goal to double the number of naturally spawning anadromous fish in the Central Valley based on a baseline period of 1967-1991. Mark-recapture efforts during the 2025-2026 lower American River escapement survey produced an escapement estimate of 63,308 fall-run Chinook salmon which is more than the previous year (45,541 FRCS) (Figure 14). However, this estimate is still far below the CVPIA doubling goal of 160,000 fall-run Chinook salmon on the American River (U.S. Fish and Wildlife Service 2015).

ACKNOWLEDGMENTS

Special thanks are due to the Bureau of Reclamation for funding this survey. We extend our appreciation to Stan Allen, Amy Roberts, and Kathy Ameral with the Pacific States Marine Fisheries Commission, and Nick Bauer with CDFW, who were instrumental in the completion of supervisory and administrative duties. We would also like to recognize Arthur Barros (CDFW), whose contribution was essential in generating the 2025 LAR escapement estimate. The successful completion of the LAR escapement survey is a direct result of the dedication of the survey crew: Stan Acres, Sean Adams, Max Bigelow Charlie Brueckner, Evan Burnett, Evan Bryant, Su Yung Chung, Katie Giuffre, Siliyah Greer, Nicholas Masi, and Jennifer O'Brien. We received additional field assistance from the following individuals: Sarah Abegglen, Emerson Albro, Harrison Beaves-Lewis, Natalie Keesaw, Emma Koertje, Saeed Latifi, Jaye Nuñez, Jessica Omura, Amanda Rae, and Lantz Virgen. Lastly, we would like to thank Lea Koerber and the crew at CDFW's Central Valley Salmonid Archive for processing CWT data obtained during the escapement survey.

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