Juvenile Salmonid Emigration Monitoring in the Lower American River, California

January – June 2024

By

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Acronyms and Abbreviations

Acronym	Definition
AFRP	Anadromous Fish Restoration Program
BBY	Bismarck Brown Y
C	Celsius
CAMP	Comprehensive Assessment and Monitoring Program
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
cm	centimeter
CVPIA	Central Valley Project Improvement Act
DO	dissolved oxygen
ESA	Endangered Species Act
FL	fork length
g	gram
GVL	Genomic Variation Laboratory
km	kilometers
LAD	length-at-date
m	meters
m/s	meters per second
mg/L	milligrams per liter
mm	millimeter
NFH	Nimbus Fish Hatchery
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
PSMFC	Pacific States Marine Fisheries Commission
rkm	river kilometer
RST	rotary screw trap
SNP	single-nucleotide polymorphism
St. Dev.	Standard Deviation
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VIE	Visual Implant Elastomer

Abstract

Operation of rotary screw traps on the lower American River in 2024 is part of a collaborative effort by the United States Fish and Wildlife Service's Anadromous Fish Restoration Program and Comprehensive Assessment and Monitoring Program, Pacific States Marine Fisheries Commission, and the California Department of Fish and Wildlife. The primary objectives of the study are to collect data that can be used to estimate the passage of juvenile fall-run Chinook Salmon *Oncorhynchus tshawytscha* and to quantify the raw catch of steelhead *O. mykiss* as well as late fall, spring, and winter runs of Chinook Salmon. Secondary objectives of trapping operations focus on collecting fork lengths and weights of juvenile salmonids, collecting fin clips to determine genetic run assignment, and gathering environmental data that will be used to develop models that correlate environmental parameters with salmonid size, temporal presence, abundance, and production.

For the 2024 sampling season, two 2.4-meter (8-foot) diameter rotary screw traps were operated downstream of the Watt Avenue Bridge on the lower American River. The 2024 Water Year was an above normal water year type, with moderate flows experienced throughout the 2024 sampling season. Sampling occurred on 121 of the 173-day season (70%) beginning on January 6 and concluding on June 26. Following genetic analysis, it was determined that a total of 83,196 fall-run, 0 spring-run, and 13 winter-run Chinook Salmon were captured, as well as 167 steelhead. Most of the juvenile salmon captured were identified as button-up fry followed by parr, silvery parr, yolk-sac fry, and smolt life stages. Seven trap efficiency trials were conducted and trap efficiencies ranged from 1.6% to 8.3%. The CAMP RST Platform Mark-Spline Model estimated a total fall-run Chinook Salmon passage of 2,775,000 (95% confidence interval = 2,479,000 to 3,086,000) at the lower American River rotary screw traps. Passage estimates for steelhead, spring-run and winter-run Chinook Salmon, and non-salmonid fish taxa were not assessed due to minimal catch.

This annual report also includes 14 appendices to describe different environmental variables and studies related to the trap site and rotary screw trap operations.

Introduction

The American River is the southernmost major tributary to the Sacramento River in California's Central Valley. Historically, the American River supported three runs of salmon, including fall (fall-run), spring (spring-run), and possibly late fall (late fall-run) Chinook Salmon (*Oncorhynchus tshawytscha,* Yoshiyama et al. 2001). However, during the California Gold Rush in the mid- to late 1800s, hydraulic mining devastated salmonid spawning habitat in the upper and lower reaches of the American River (Fisher 1994). Additionally, the construction of Folsom and Nimbus Dams in 1955 made passage impossible for salmonids to migrate into the upper portions of the American River watershed. Nimbus Fish Hatchery (NFH) was constructed in 1958 to mitigate the loss of spawning and rearing habitat for Chinook Salmon and Central Valley steelhead *O. mykiss*. Located 0.8 kilometers (km) downstream of Nimbus Dam, the hatchery continues to produce large numbers of fall-run Chinook Salmon and steelhead. However, hydropower implementation, over-harvest, introduced species, loss of preferential habitat, and other factors continue to contribute to the decline of these salmonid populations (Yoshiyama et al 2001, Lindley et al 2006, NMFS 2019). Today, the portion of the American River below Nimbus Dam, known as the lower American River, provides the only spawning and rearing habitat in the American River watershed for Chinook Salmon and steelhead.

In order to help protect, restore, mitigate, and improve the natural production of salmonids in the Central Valley, the Central Valley Project Improvement Act (CVPIA) was established in 1992. One of the primary goals of the legislation was to facilitate efforts that enhance and restore the natural production of juvenile Chinook Salmon and steelhead. Pursuant to that act, several programs were established to help recover salmonid populations. In 1997, the Comprehensive Assessment and Monitoring Program (CAMP) Implementation Plan was developed to evaluate the effectiveness of CVPIA actions in restoring anadromous fish production. The CVPIA programs are currently engaged in habitat restoration activities within the American River watershed including the Anadromous Fish Restoration Program (AFRP), Dedicated Project Yield Program, and Spawning Gravel Programs (USBR 2019).

In an effort to improve salmonid spawning habitat on the lower American River, the United States Bureau of Reclamation (USBR), the California Department of Fish and Wildlife (CDFW), and the CVPIA's AFRP and Spawning Gravel Programs have collaborated to implement the lower American River Gravel Augmentation and Side-Channel Habitat Enhancement Project (USDOI 2008). This project is ongoing and has been integral in increasing and restoring the adult spawning and juvenile rearing habitat that was adversely affected by the construction of the Folsom and Nimbus Dams. Habitat restoration activities are ongoing and have occurred at the base of Nimbus Dam (Nimbus Basin) downstream to River Bend at river kilometer (rkm) 20.9 (Figure 1, USBR 2019).

In addition, the CVPIA's Dedicated Project Yield Program Section (b)(2), commonly referred to as "(b)(2) water," authorizes a portion of the Central Valley Project water yield to be dedicated and managed for the benefit of fish and wildlife. As it pertains to the lower American River, (b)(2) water can be used to augment base flows out of Nimbus Dam to improve in-stream conditions for fall-run Chinook Salmon and Central Valley steelhead during critical life stage periods. The (b)(2) water's flow augmentation may also contribute to the AFRP Final Restoration Plan flow objectives for the lower American River (USBR Section 3406).

Continuous restoration, management, and monitoring activities are needed to preserve healthy populations and further aid in the recovery of species listed under the United States Endangered Species Act (ESA). These listed species include rearing *Endangered* Sacramento River winter-run Chinook Salmon as well as the *Threatened* Central Valley Spring-run Chinook Salmon and steelhead populations. To this end, in 2014 the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) developed a recovery plan which places a high priority on salmonid habitat restoration activities in the American River (NMFS 2014).

The lower American River rotary screw traps (RSTs) monitor juvenile salmonid abundance to help determine if habitat restoration activities and flow management practices are resulting in a positive impact for fall-run Chinook Salmon and steelhead production. Furthermore, this report presents monitoring data assessing the temporal variability in steelhead, spring-run, and winter-run abundance, and describes biological data of salmonids and other native and non-native fish species in relation to environmental conditions.

Study Area

The American River watershed covers an area of 4,900 square kilometers (km^2). The upper-most headwaters reach an elevation of 3,170 meters (m) on the western slopes of the Sierra Nevada range (James 1997). The river contains three major forks (North, Middle, and South forks) that converge at Folsom Reservoir, which is impounded by the Folsom Dam 32 km northeast of the city of Sacramento (USACE 1991). The water exiting Folsom Reservoir flows into Lake Natoma, which is impounded by Nimbus Dam. The USBR regulates water management activities for these two dams including river discharge and water temperature to help administer flood protection, provide municipal and agricultural water supplies, generate hydroelectric power, and maintain fish and wildlife habitats.

Water exiting Nimbus Dam flows downstream through the lower American River for 36 km until it reaches the confluence with the Sacramento River (Figure 1). This lower stretch of the American River is currently the only portion that salmonids are able to access. Historically ranging in flows from 500 cubic feet per second (cfs) to upwards of 164,000 cfs, the lower American River is now constricted and straightened by a levee system that was engineered for flood control during the urban development of Sacramento County. The river contains gravel bar complexes, islands, flat-water areas, and side-channel habitat characteristics (Merz and Vanicek 1996). However, only a small portion of the lower American River possesses quality rearing habitat for juvenile salmonids and substrate that is suitable for anadromous salmonid spawning. The primary salmonid spawning grounds are relegated to the uppermost portion of the lower American River between Sailor Bar (rkm 34.7) and the Lower Sunrise Recreational Area (rkm 31.1; Kelly and Phillips 2020). A site below the Watt Avenue Bridge (rkm 14.6) was selected by CDFW as the optimal location to install and operate RSTs. The site was chosen for its distance downstream of most salmonid spawning activities on the lower American River and its distance upstream from the Sacramento River (Snider and Titus 2001).

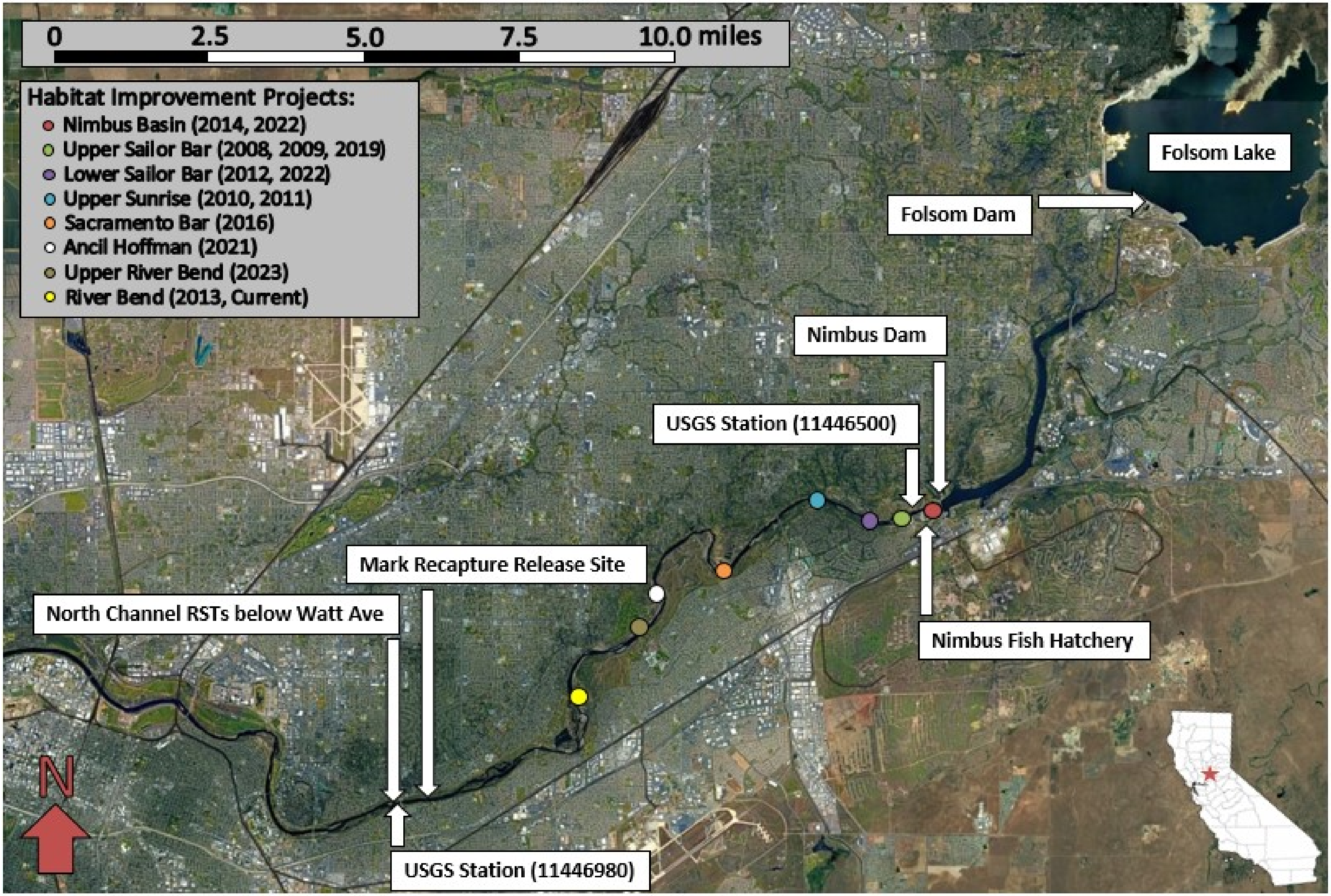

Figure 1: Points of interest on the lower American River.

The lower American River RST site is located 0.2 rkm downstream of the Watt Avenue Bridge (Figure 2). During typical flow years, the American River at this location separates into two channels that pass on either side of a gravel island. The north channel carries most of the water volume and becomes the only channel with flowing water during flows of less than approximately 500 cfs. The north channel has a steep gradient that causes relatively high water velocities, while the south channel has a flatter gradient and lower water velocities. During flows above approximately 10,000 cfs the gravel island separating the north and south channels becomes submerged and the lower American River below Watt Avenue becomes one channel (Appendix 1).

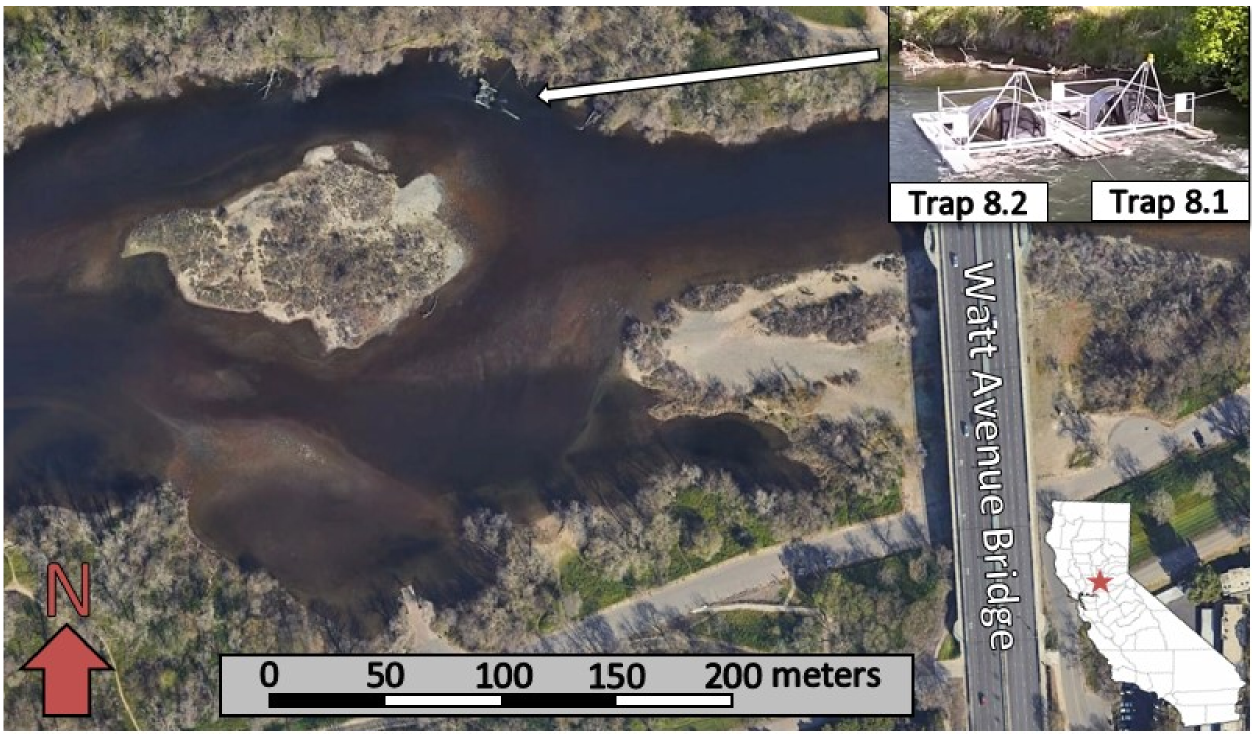

Figure 2: RST location in the north channel of the lower American River captured by Google Earth in February of 2022. Inset image illustrates the side-by-side trap configuration.

Methods

Safety Measures

All crew members were trained in RST and boat operation safety. Each crew member was required to read the Pacific States Marine Fisheries Commission (PSMFC) Safety Manual, acknowledge the PSMFC Safety Orientation Checklist, and was required to complete California's boating safety course prior to operating a motorized vessel (PSMFC 2021).

For night operations, each crew member was required to attach a strobe light (ACR HemiLight 3) to their personal flotation devices that would turn on automatically if submerged in water. Navigation lights and a bow mounted 55-watt halogen driving light were also installed on the jet boat during night operations.

Public safety measures were also taken. Signage warning river recreationalists to "Keep Away" in English and Spanish were affixed to the traps as well as to the bank 125 and 250 m upstream of the traps. Solar-powered amber strobe lights, that automatically turn on in low light conditions, were attached to the outermost railings of each trap to alert the public at night of the navigational hazard. Reflective orange and yellow buoys were placed on the anchor lines and chain bridals to help prevent boaters from crossing in front of or over the anchor lines. Weekend sampling was suspended in the middle of May to allow river recreationalists the safest passage during periods of peak river use. This included raising both trap cones, removing live well screens, and shifting traps out of the thalweg (hereafter referred to as "taken out of service") until the following Sunday evening.

Trap Operations

Two 2.4-m (8-foot) diameter RSTs (EG Solutions) were deployed in the north channel in a side-by-side orientation and were designated as Trap 8.1 and Trap 8.2 (Figure 3). Trap 8.1 was set closer to the north side of the north channel, while Trap 8.2 was set closer to the south side of the north channel. Traps were anchored to large concrete blocks set into the river channel's cobble substrate using 0.95 centimeter (cm) nylon coated galvanized cable and a 0.95 cm chain bridal attached to the front of each trap's pontoons.

Figure 3: The two north channel 8-foot RSTs, Trap 8.1 (right) and Trap 8.2 (left), on the lower American River downstream of the Watt Avenue Bridge.

Trap checks were conducted at least once every 24 – 28 hours while traps were actively sampling in the cone-down configuration. During large storm events or exceptionally high discharge events when increases in debris size or quantity could hinder trap functionality and potentially increase fish mortality, multiple trap checks were conducted in a 24-hour period.

However, in cases where storms, flow increases, or debris loads were deemed severe enough, traps were taken out of service until conditions improved.

On daily trap visits, trap function was assessed as “functioning normally,” “functioning, but not normally,” or “stopped functioning.” If the trap was functioning, the revolutions per minute was recorded. If the trap was not functioning upon arrival, the trap was restored to its normal function without raising the cone. Subsequently, trap intakes were checked and recorded as “clear,” “partially blocked,” “completely blocked,” or “backed up into cone.” After collecting environmental data and cleaning the trap, time and total cone rotations were recorded using an electronic hubodometer (Veeder-Root TR 1000-000) mounted to the axle of the trap inside of the live well.

Environmental Parameters

During trap visits, various environmental parameters were recorded at least once per visit. Instantaneous temperature degrees Celsius (C) and dissolved oxygen (DO; milligrams per liter [mg/L]) were measured using a YSI Ecosense DO 200A meter (Yellow Springs Instruments), velocity (meters per second [m/s]) was measured in front of each cone using a Global Water FP111 flow probe, and turbidity (nephelometric turbidity unit [NTU]) was collected in front of each cone and measured using a portable turbidity meter (Eutech; Model TN-100). When water depth was less than 3 m, a depth rod was used to record water depth to the nearest cm on the port and starboard side pontoons in line with the front of the trap cones. Average daily river discharge (cubic feet per second [cfs]) was calculated from instantaneous measurements recorded 21 rkm upstream of the RSTs from the United States Geological Survey (USGS) American River at Fair Oaks monitoring station (USGS station number 11446500). Average daily river temperature (C) was calculated from instantaneous measurements recorded 0.16 rkm upstream of the RSTs from the USGS American River below Watt Avenue Bridge station (USGS station number 11446980, Figure 1). Also, average daily river discharge (cfs) was calculated from instantaneous measurements from the USGS Sacramento River at Verona monitoring station (USGS station number 11425500), and staff gauge (ft) was calculated from instantaneous measurements from the California Data Exchange Center (CDEC) American River at H Street Bridge station (CDEC station number SAMC1). Ultimately, the USGS American River at Fair Oaks and USGS Sacramento River at Verona monitoring stations were compared against the H Street Bridge station to help explain river height changes and whether Sacramento River backflow up the American River was occurring.

Catch and Fish Data Collection

Fish Collection

On each visit, before clearing the live well of debris and fish, one or two workstations were set up per trap. A workstation included an 18-gallon (68.1 liter) tub and multiple 5-gallon (18.9 liter) holding buckets filled with fresh river water, a measuring board, a net, and tongs

(Figure 4). To begin, a rake was used to incrementally remove debris from the live well by placing approximately 2 or 3 scoops (3 - 5 gallons) into the 18-gallon tub. Then, a smaller scoop (approximately 0.3 gallons) of debris was removed from the 18-gallon tub and placed onto the measuring board. Tongs were then used to spread out the debris to carefully scan and ensure any fish trapped in debris were removed and placed into their respective 5-gallon holding bucket. All aquatic or terrestrial debris was placed into a separate 5-gallon bucket to measure and record the total debris quantity of each live well before being discarded downstream.

Figure 4: Trap workstation, consisting of an 18-gallon tub, multiple 5-gallon holding buckets, a measuring board, and tongs, on the lower American River.

Fish were separated based on species, race, and marks. Length-at-date (LAD) criteria developed for the Sacramento River was used to assign the run at capture for Chinook Salmon to separate suspected ESA listed spring- and winter-run (Greene 1992). Additionally, salmonids were assessed for marks. Ultimately, fish were separated into different buckets for: 1) all spring- and winter-run Chinook Salmon, 2) all steelhead, 3) unmarked fall-run and late fall-run Chinook Salmon, 4) marked fall-run Chinook Salmon, and 5) all other fish. Salmonids with an intact adipose fin were presumed to be natural origin whereas salmonids with a clipped adipose fin were classified as hatchery origin.

During the 2024 sampling season, the NFH conducted multiple in-river releases. They typically adhered to the standard constant fractional marking rate, clipping the adipose fin of 25% of hatchery-origin Chinook Salmon and 100% of hatchery-origin steelhead (CDFW 2017). On April 19, they released 841,000 hatchery-origin fall-run Chinook Salmon, and between January 31 and February 2, they released 516,000 hatchery-origin steelhead which followed these tagging rates. However, the total in-river release of approximately 2.4 million fall-run

Chinook Salmon fry for the parentage-based tagging study on February 12 and February 20 lacked any markings (i.e., adipose clips), making it impossible to distinguish between natural and hatchery-origin populations in the field.

Maintaining fish health by keeping stress and handling to a minimum was a top priority. Each 5-gallon holding bucket was setup to allow for fast and easy water exchange with the top quarter of each bucket perforated with 3/16” holes. Additionally, DO and temperature were maintained utilizing 12V aerators, frozen water bottles, and umbrellas for shade to keep holding buckets within 2 C of the river temperature. Overcrowding was also avoided by placing no more than 120 fry, 80 parr, or 50 smolts in a single bucket. Upon reaching capacity, a perforated screw top lid was secured so each holding bucket could be submerged in the river to ensure safe DO and temperature until the fish were ready to be processed.

To avoid a size bias, fish that were collected while sorting debris were only included in the subsample if not enough fish could be netted from the live well for a complete subsample (Table 1). Fish that were not held for the subsample were assessed for marks, enumerated, and designated as either a “live plus-count tally” or “mort plus-count tally,” an unassigned life stage category.

Table 1: Subsample size for fall, spring and winter runs of Chinook Salmon, steelhead, and non-salmonid species captured for each trap on the lower American River.

	Winter Chinook	Spring Chinook	Fall Chinook	steelhead	Hatchery Salmonids	Recaptured Chinook	Non-Salmonid Species
Enumerate	All	All	All	All	All	All	All
Life Stage	50	50	100	100	50	50	50
Measure	50	50	100	100	50	50	50
Weigh	25	25	100	100	0	0	0
Mortality	All	All	All	All	All	All	All

Fish Processing

Fish were processed 0.2 rkm downstream of the traps on an island with adequate shade and secluded from the general public. Upon arriving, fish condition was checked before buckets were secured to the boat and re-submerged in the river. A fish workstation was then setup with a 1-gallon (3.8 liter) anesthetic tank, 5-gallon recovery bucket, digital scale (OHAUS Scout Pro), measuring board, and genetic sampling equipment (Figure 5). When processing fish began, one holding bucket would be removed from the river and affixed with a 12v aerator and frozen water bottle. Species that were identified through the LAD criteria as ESA listed (spring-run and winter-run) and natural origin steelhead were always processed and released first, followed by unmarked fall-run or late fall-run, marked salmonids, and all other non-salmonid species. Fish were anesthetized to reduce stress during handling using a solution of 0.5 – 2 tabs of Alka Seltzer Gold and 1 milliliter (ml) stress coat (API Stress Coat Plus) per gallon of river water. Dosage was adjusted dependent upon fish size, species, DO, and water temperature. The crew diligently monitored operculum activity of fish immersed in the anesthetic solution, with reduced gill activity indicating fish were ready to be processed.

Figure 5: Fish processing station, consisting of an anesthetic tank, 5-gallon recovery bucket, digital scale, measuring board, and genetic sampling equipment.

Data was collected on all species but varied by species and run (Table 1). Fork length or total length was recorded to the nearest millimeter (mm). Weight was recorded to the nearest 0.1 gram (g) for up to 100 natural origin salmonids greater than or equal to 40 mm. Salmonid life stages were assessed by following the criteria of the smolt index rating (Table 2, Figure 6). Lamprey life stages were identified as ammocoete (larval), macrophthalmia (juvenile), or adult. All other non-salmonid species were identified as either a juvenile or adult life stage. When applicable, the presence of marks from past trap efficiency trials or the absence of an adipose fin on a fish was noted. The mortality status (live or dead) for each fish was recorded. Whenever possible, live fish were used for the subsample, since decomposition can alter body size, weight, and color, making accurately measuring and identifying life stages more difficult. In those cases, mortalities were considered to be a “mort plus-count.” Genetic samples were collected from all LAD winter-run Chinook Salmon. Additionally, genetic samples were collected from a subsample of LAD fall-run, late fall-run, and spring-run Chinook Salmon. After being processed, each fish was placed into an aerated recovery bucket containing 5 ml stress coat before being released downstream of the RSTs.

Table 2: Smolt index rating for assessing life stage of Chinook Salmon and steelhead adapted from CAMP (2008).

Smolt Index	Life Stage	Morphological Criteria
1	Yolk-sac fry	* Newly emerged with visible yolk-sac
2	Button-up Fry	* Recently emerged with yolk-sac absorbed * Seam along mid-ventral line visible * Pigmentation undeveloped
3	Parr	* Seam along mid-ventral line not visible * Scales firmly set * Darkly pigmented with distinct parr marks * Minimal silvery coloration
4	Silvery Parr	* Parr marks visible but faded * Intermediate degree of silvering
5	Smolt	* Parr marks highly faded or absent * Bright silver or nearly white coloration * Scales easily shed (deciduous) * Black trailing edge on caudal fin * Body/head elongating
6	Adult	* ≥ 300mm

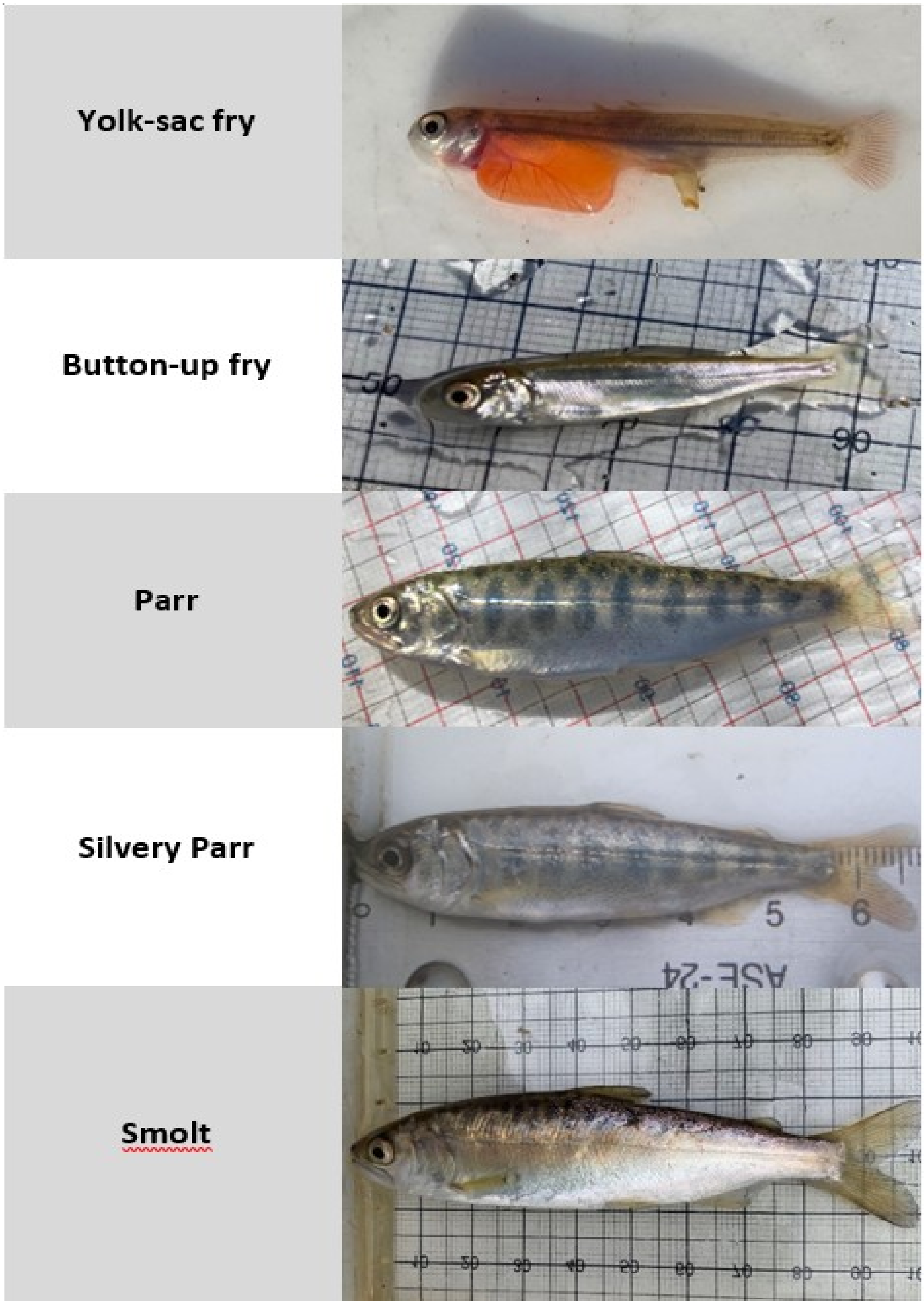

Figure 6: Examples of life stages for Chinook Salmon according to the smolt index rating.

Fin Clip Collection

To evaluate the accuracy of the LAD criteria, Chinook Salmon fin clips were collected to accurately determine run assignment through genetic analysis. Fin clips approximately 1 - 2 mm^2 were taken from the upper caudal lobe using disinfected dissection scissors. Clips were stored in 2 ml vials filled with 100% ethanol in a cool location away from direct sunlight. To establish a genetic baseline, up to 3 clips per week were taken from LAD fall-run Chinook Salmon. Due to the highly variable annual catch of LAD late fall-run, spring-run, and winter-run Chinook Salmon, up to 10 clips per week from non-fall run were collected upon capture.

Each fin clip sample was split, with half the genetic sample sent to the CDFW Tissue Archive for storage and the other half to the United States Fish and Wildlife Service's (USFWS) Abernathy Fish Technology Center to assign genetic run using the panel of single-nucleotide polymorphism (SNP) markers described by Clemento et al. (2014). This panel of SNPs was developed by staff from NOAA Fisheries and is now used for multiple applications by the USFWS and several partner groups (Christian Smith, USFWS, pers. comm.). Detailed methods for DNA extraction, genotyping, and run assignment are described in Abernathy Fish Technology Center Standard Operating Procedure #034.

After receiving genetic results, the SNP panel's probabilities that exceeded the 50% threshold were used to assign final run assignment for all genetically sampled fish. For all LAD fall-run Chinook Salmon that were not genetically sampled, a final run assignment of fall-run was applied as the LAD criteria continued to accurately assign this run. Conversely, for all LAD late fall-run and spring-run Chinook Salmon that were not genetically sampled, a final run assignment of fall-run was applied as the LAD criteria continued to inaccurately assign this run (PSMFC 2013 – 2023).

In collaboration with CDFW, 871 upper caudal Chinook Salmon fin clips were randomly collected from February through June as part of the CDFW parentage-based tagging study following the NFH release of approximately 2.4 million hatchery Chinook Salmon fry on February 12 and February 20. The fin clips were collected for genetic analysis and sent to the CDFW Tissue Archive. The fin clips were collected to determine if the hatchery released fry are following the same migratory cues and timing as natural origin Chinook Salmon, and evidently, will help estimate how many of these released fish will return for spawning as adults.

In coordination with the UC Davis Genomic Variation Laboratory (GVL), opportunistic fin clips from adult and juvenile Pacific Lamprey *Lampetra tridentata* and River lamprey *Lampetra ayresii* were collected for genetic analysis to better understand gene flow and population structure. Details and protocols for the GVL lamprey project can be found under California Scientific Collecting Permit #10509.

Trap Efficiency

Trap efficiency trials were conducted to scale observed catch up to estimate the total passage of fall-run Chinook Salmon migrating past the site. These trials quantified the proportion of fall-run Chinook Salmon captured by the RSTs on the lower American River. Efficiency trials were conducted with marked Chinook Salmon, ideally using fish captured in the RSTs, but when catches were insufficient, hatchery Chinook Salmon were provided by CDFW.

The first method of marking consisted of dyeing the whole body of a Chinook Salmon with Bismarck Brown Y (BBY) stain when the average fork length was less than 60 mm (Figure 7). Chinook Salmon used in the trial were placed into an aerated 37-gallon insulated tub and stained using a solution of 0.6 g of BBY for every 10 to 15 gallons of water. Fish were stained for approximately two hours with fish condition constantly monitored during the staining process. After staining, the marked fish were placed into a 50-gallon live car attached to the rear of the traps and held overnight until twilight of the following evening before being transported and released at the release site (Figure 1).

Figure 7: A group of unmarked Chinook Salmon and whole body BBY stained Chinook Salmon.

The second method consisted of using a Visual Implant Elastomer (VIE) tag when most of the Chinook Salmon had a fork length greater than 60 mm (Figure 8). VIE tagging consisted of inserting a syringe and injecting a small amount of colored elastomer just under the skin of the snout of an anesthetized Chinook Salmon. After tagging, the marked fish were placed into a 50-gallon live car attached to the rear of the traps and held until twilight or twilight of the following evening before being transported and released at the release site. Tagging supplies, mixing procedures, and protocols for VIE tags were from Northwest Marine Technology, Inc.

Figure 8: Chinook Salmon marked with a pink VIE tag on the snout.

At least 700 Chinook Salmon were used to conduct each trap efficiency trial with BBY stain or VIE tags. If less than 700 fish were captured on a given day, Chinook Salmon were provided by the NFH.

The trap efficiency release site was approximately 1.3 rkm upstream of the traps (Figure 1). Marked salmon were evenly scattered across the width of the river in small groups using dip nets to avoid schooling during release. A boat was used to release fish off the bow while keeping the motor upstream of the released fish. All releases occurred close to twilight to minimize depredation.

On trap visits following release, crew members looked carefully for any BBY or VIE marked fish in the RST live wells. Due to the proximity of the release location to the RSTs, most of released fish were found to migrate past the site within four days, and, since the BBY likely fades after 14 days, trial periods were designated as a minimum of four days and maximum of 14 days. During this period, a subsample of 50 recaptured (marked) Chinook Salmon from each trap were measured for fork lengths, assessed for life stage, and evaluated for mortality status. If more than 50 recaptures were found in a single RST live well, marked salmon in excess of 50 were enumerated and classified as a "live recap plus-count tally" or "mort recap plus-count tally."

Retention in Analysis

Under ideal circumstances, the RSTs function normally and continuously between trap visits. However, trap stoppages and abnormal trap functionality can adversely affect catch which ultimately would misrepresent passage estimates. To account for this, if the trap was stopped upon arrival and determined to have been functioning normally for less than 70% of the sampling period, the data was excluded from the analysis. This threshold was calculated by using the trap revolutions per hour after cleaning the trap, the total revolutions of the cone, and the duration of the sampling period. The estimated total revolutions (Equation 1) are used to determine the normal functioning percent (Equation 2), which is a proportion of the actual total revolutions to the estimated total revolutions the trap had been functioning normally during that sampling period. For the sampling periods excluded from analysis, the CAMP RST platform treated these periods as if the RSTs were not fished and imputed catch was used to estimate passage for gaps in sampling of seven or less days.

$$Equation\ 1: \quad Hours\ Fished * Revolutions\ (per\ hour) = Estimated\ Total\ Revolutions$$

$$Equation\ 2: \quad \frac{Actual\ Total\ Revolutions}{Estimated\ Total\ Revolutions} * 100 = Normal\ Functioning\ Percent$$

Exclude from Analysis: Normal Functioning Percent < 70%

Passage Estimates

Fall-run Chinook salmon passage estimates were derived from the CAMP RST Platform Mark-Spline Model which is a generalized additive model (GAM). Passage estimates derived from this model are provisional. Once a more advanced model is developed, these numbers will change. Passage estimates were not assessed for other runs of Chinook Salmon or steelhead due to minimal catch.

The GAM incorporated two elements in the development of the salmon passage estimates; the number of salmon caught by trap *i* on day *j*, and the estimated efficiency of trap *i* on day *j*.

Salmon passage at trap *i* on day *j*, $\hat{N}_{ij}$, was calculated as:

$$\hat{N}_{ij} = \frac{\hat{c}_{ij}}{\hat{e}_{ij}}$$

where $\hat{c}_{ij}$ was either the enumerated or estimated catch of unmarked salmon of a certain life stage or run at trapping location *i* at that location during the 24-hour period j. For example, c_{23} was estimated catch at the second trapping location during day three; and

$\hat{e}_{ij}$ was estimated trap efficiency at trapping location *i* of the site for a certain life stage or run during the 24-hour period *j.* For example, e_{23} was estimated efficiency at the second trapping location during day three.

Estimation of $\hat{c}_{ij}$

The estimate of catch, $\hat{c}_{ij}$, was computed in one of the following ways. The method used was typically selected in the order listed below, e.g., if a trap fished for more than 22 hours within a 24-hour period, the catch using Method #1 was used to calculate a trap's salmon production estimate. If the trap fished for less than 22 hours within a 24-hour period, Method #2 was used. Additionally, if the 24-hour period between day *j* and day *j*-1 contained more than two hours of sampling excluded from analysis, this length of time excluded from analysis was treated as a gap in sampling, and Method #2 was used.

Method #1: If the interval between day *j* and day *j* – 1 was 22 hours or more and the trap fished for the entire period, $\hat{c}_{ij}$ was the total catch of unmarked fish for day *j*.

Method #2: If the trap fished for less than 22 hours in the 24-hour period between day *j* and day *j* – 1, the fish count for day *j* was adjusted using a GAM. This model smoothed observed catch rates (fish per hour) through time much like a moving average. The prediction from this model was multiplied by the number of hours the trap was not sampling during the 24-hour period to compile an estimated catch for the day. For example, if the trap fished for 10 hours in the 24-hour period between day j and day j-1, catch for the 14 hours not fished was calculated using the GAM and added to the catch for the 10 hours fished to estimate $\hat{c}_{ij}$.

Estimation of $\hat{e}_{ij}$

Efficiency estimates at trapping location *i* on day *j* were computed from a binomial GAM unless sufficient efficiency trials (≥ 3 per week) had been performed. Thus, if sufficient efficiency trials had been conducted (≥ 3 per week), efficiency from the most recent trial was used for $\hat{e}_{ij}$. When the most recent efficiency was not appropriate (i.e., < 3 trials per week), a binomial GAM was fitted to past and current efficiency trials and used to compute $\hat{e}_{ij}$. The additive portion of this GAM was:

$$\log\left(\frac{E[\hat{e}_{ij}]}{1 - E[\hat{e}_{ij}]}\right) = s(j)$$

where $s(j)$ was a smooth (spline) function of the day index (i.e., smooth function of Julian date).

If less than 10 efficiency trials were conducted during the survey season or less than 10 efficiency trials were included in analysis, the average trap efficiency for the survey season was used to expand the daily trap catches. Furthermore, if less than 10 efficiency trials were included in the analysis or on sampling days during the portion of the year when trap efficiency tests were not conducted, a GAM was not used to estimate trap efficiency, and $\hat{e}_{ij}$ was the average efficiency for the trap efficiency tests that were conducted and included in analysis during the survey season. For example, if a survey season occurred between January 1 and June 30 and at least 10 trap efficiency tests were conducted and included in analysis between February 1 and May 30, a GAM was used to develop the estimated trap efficiencies and expand the daily trap catches between February 1 and May 30, and the average trap efficiency for the survey season was used to expand the daily trap catches before February 1 and after May 30.

Estimation of $\hat{N}_{ij}$

Once $\hat{c}_{ij}$ and $\hat{e}_{ij}$ are estimated, abundance estimates for the site were computed. The total number of fish passing a particular site on day *j* was computed as:

$$\hat{N}_j = \sum_{t=1}^{n_{ij}} \hat{N}_{ij}$$

where n_{ij} was the number of trapping locations fishing at site *i* during day *j*. Passage on day *j* was then summed over a week, month, or year to produce weekly, monthly, or annual estimates of abundance for a particular site. If multiple traps were operated during a sampling season, passage estimates were calculated for each trap, and subsequently, the passage estimate for each trap were averaged together to provide a total estimated passage.

Confidence Interval Estimates

Confidence intervals were computed using parametric bootstrap or Monte Carlo methods as described in the “Feasibility of Unified Analysis Methods for Rotary Screw Trap Data in the California Central Valley,” by McDonald and Banach (2010).

Fulton’s Condition Factor

Fall-run Chinook Salmon condition was assessed using Fulton’s condition factor. Each day, up to 100 Chinook Salmon greater than or equal to 40 mm were measured for weight and fork length. Higher condition factor values indicate heavier fish relative to their fork length. The condition factor was calculated using the following equation:

$$Fulton's\ Condition\ Factor = \left(\frac{Weight\ (g)}{Fork\ Length\ (mm)^3}\right) * 100{,}000$$

Results

Trap Operations

Traps 8.1 and Trap 8.2 began sampling on January 6, 2024, and concluded June 26, 2024, with 121 days of sampling effort in the 173-day season (70%, Figure 9). Of the 121 days of sampling effort, Trap 8.1 sampled successfully for approximately 2,812 hours (99%) and sampled unsuccessfully for approximately 32 hours (1%; Figure 10), while Trap 8.2 sampled successfully for approximately 2,726 hours (99%) and sampled unsuccessfully for approximately 30 hours (1%; Figure 11). Sampling was suspended for a total of 52 days with one outage greater than seven days. This included suspending sampling operations for backflow (23 days in February), weekend shutdowns (15 days), storms (5 days), NFH steelhead release (5 days), and the NFH Chinook Salmon release (4 days). Additionally, Trap 8.2 was offline an additional four more days than Trap 8.1 (between June 4 and June 7) due to excessive algae issues.

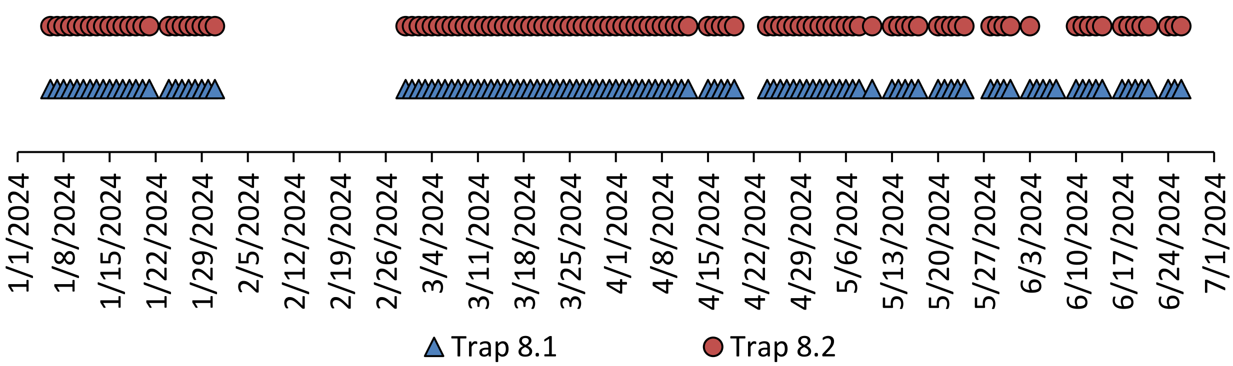

Figure 9: Dates sampling occurred during the 2024 lower American River RST sampling season.

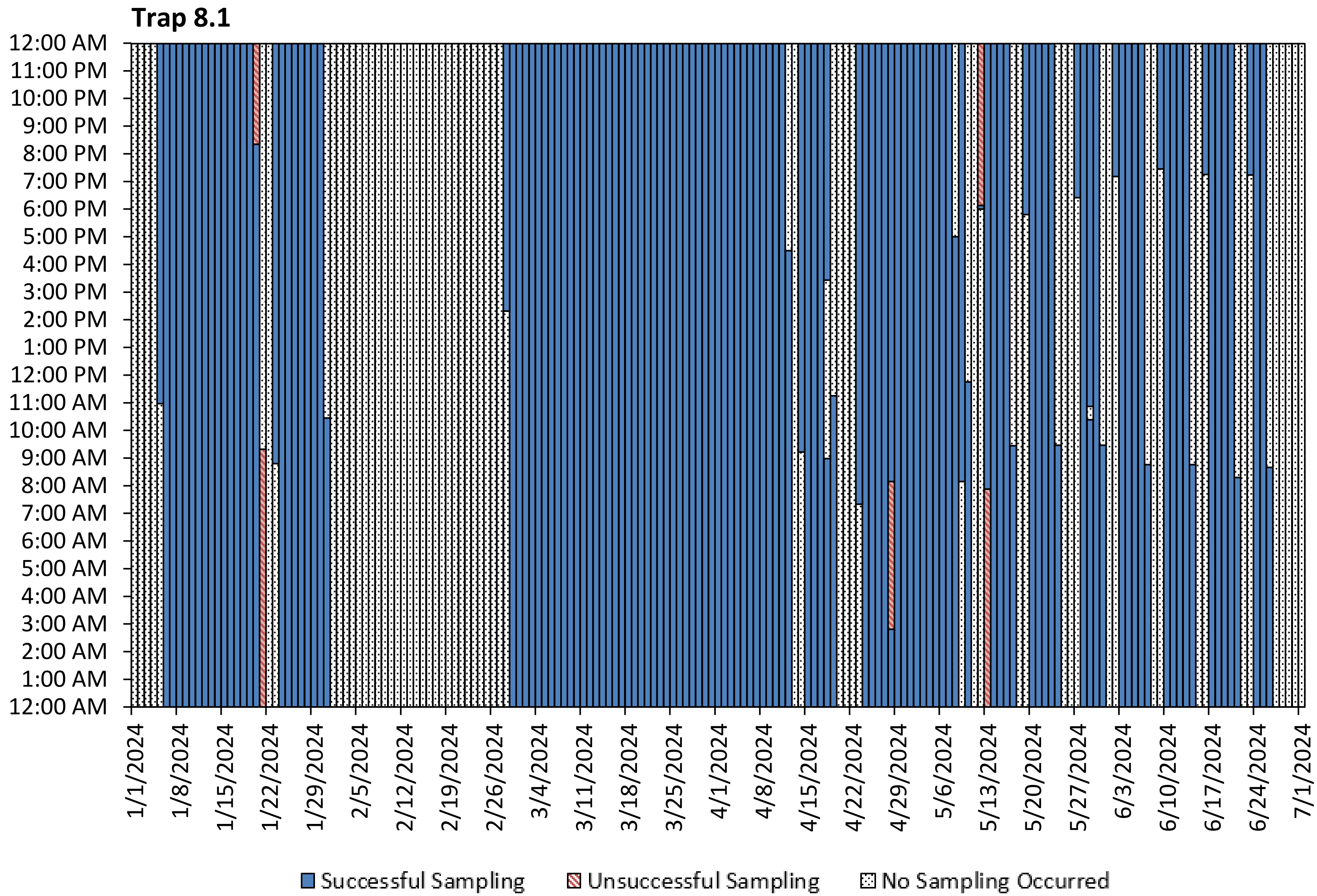

Figure 10: Daily hours Trap 8.1 sampled successfully, sampled unsuccessfully, or did not sample during the 2024 lower American River RST sampling season.

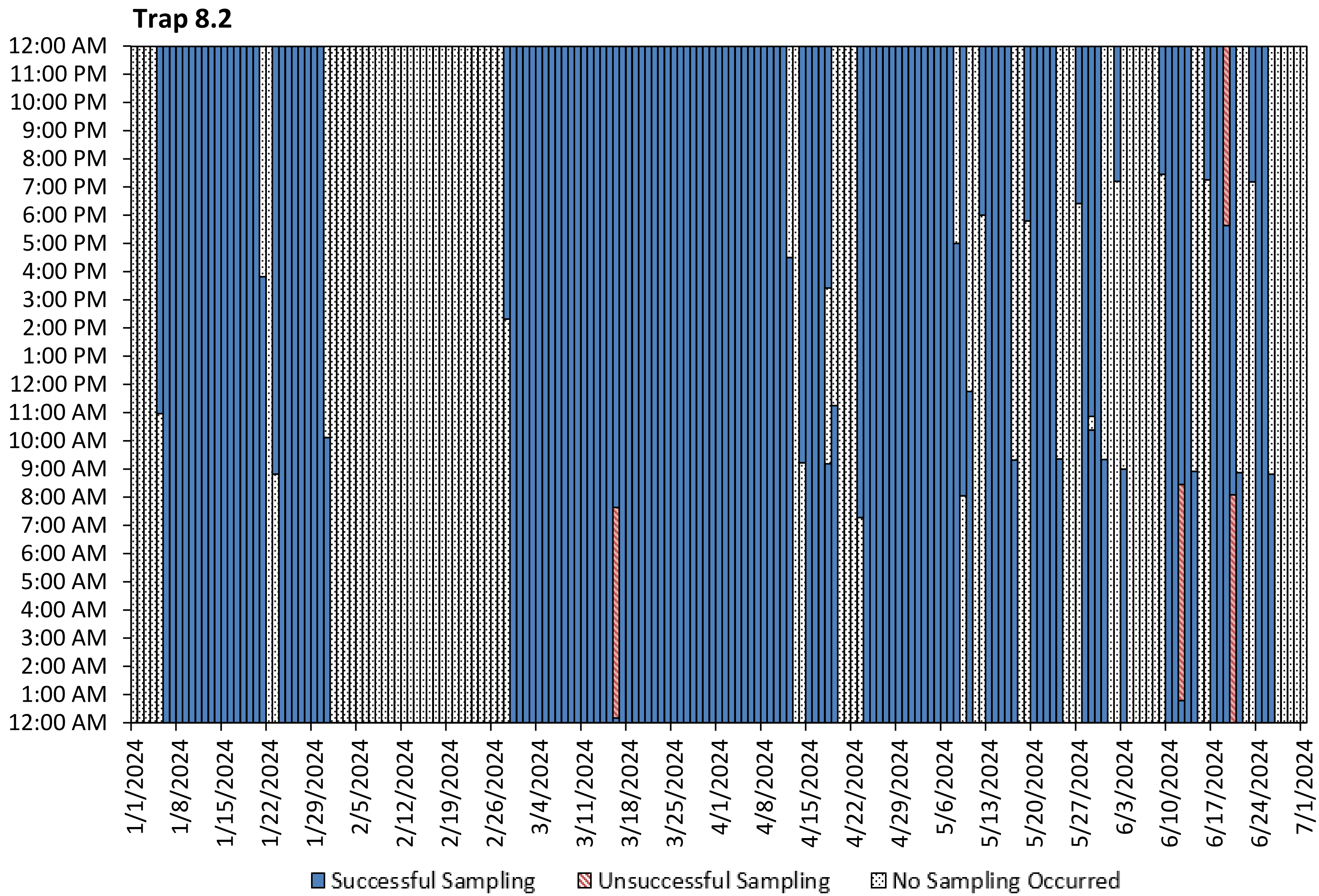

Figure 11: Daily hours Trap 8.2 sampled successfully, sampled unsuccessfully, or did not sample during the 2024 lower American River RST sampling season.

Environmental Summary

The 2024 sampling season was met with relatively constant flows. However, storms and high releases in February and March from Shasta and Oroville Dams coupled with moderate releases from Nimbus Dam caused water from the Sacramento River to backflow up the American River. Specifically, the H Street gauge averaged 17.4 ft (range: 16.5 - 18.2 ft) in the months of January and April through June, and averaged 20.7 ft (range: 16.6 – 24.2 ft) in the months of February and March. The maximum H Street gauge value was observed on February 23, which coincided with peak flows at Verona. Additionally, it appeared that once flows reached approximately 50,000 cfs at the Verona gauge, the H Street staff gauge began to increase at a significantly quicker rate (Figure 12). Evidently at flows greater than 50,000 cfs at Verona, the RST site observed lower than expected river velocities and a high quantity of debris during this period of backflow. As a result, sampling was paused and there was a significant gap in data collection (see Appendix 1 and Appendix 2 for photos illustrating the backflow).

Otherwise, environmental parameters remained relatively ordinary during the 2024 sampling season (Appendix 3). Measurements taken in the field, such as DO, turbidity, and velocity only reflect days when sampling occurred. Instantaneous river discharge, recorded in 15-minute intervals by USGS, reached a minimum on February 3 and February 4, and a maximum on March 8 (range: 1,670 – 6,520 cfs; Figure 13). Instantaneous river temperature, also recorded in 15-minute intervals by USGS at the Watt Avenue gauge station, recorded a minimum on January 11, January 12, and February 10, and a maximum on June 5 and June 6 (range: 9.0 – 19.0 °C; Figure 13).

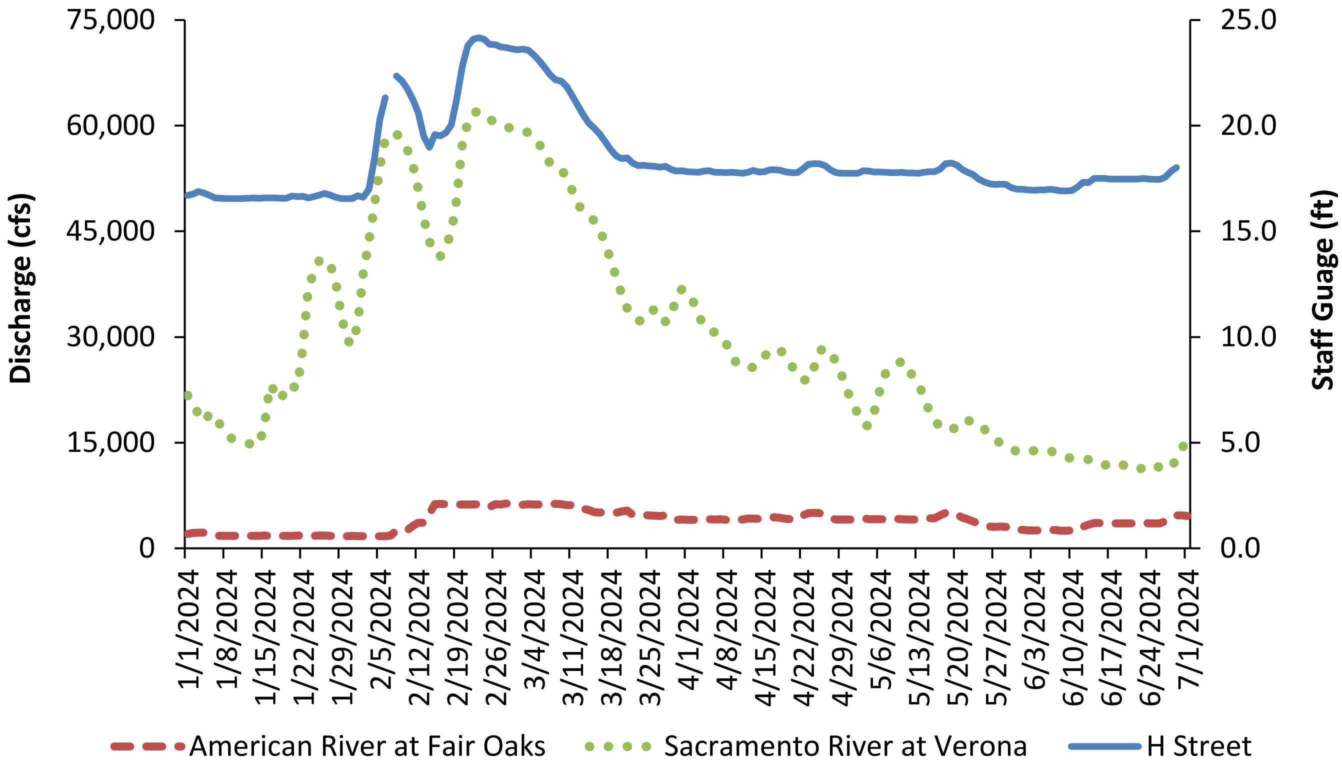

Figure 12: Daily average discharge (cfs) measured at Fair Oaks, daily average discharge (cfs) measured at Verona, and daily average staff gauge (ft) measured at H Street during the 2024 lower American River RST sampling season.

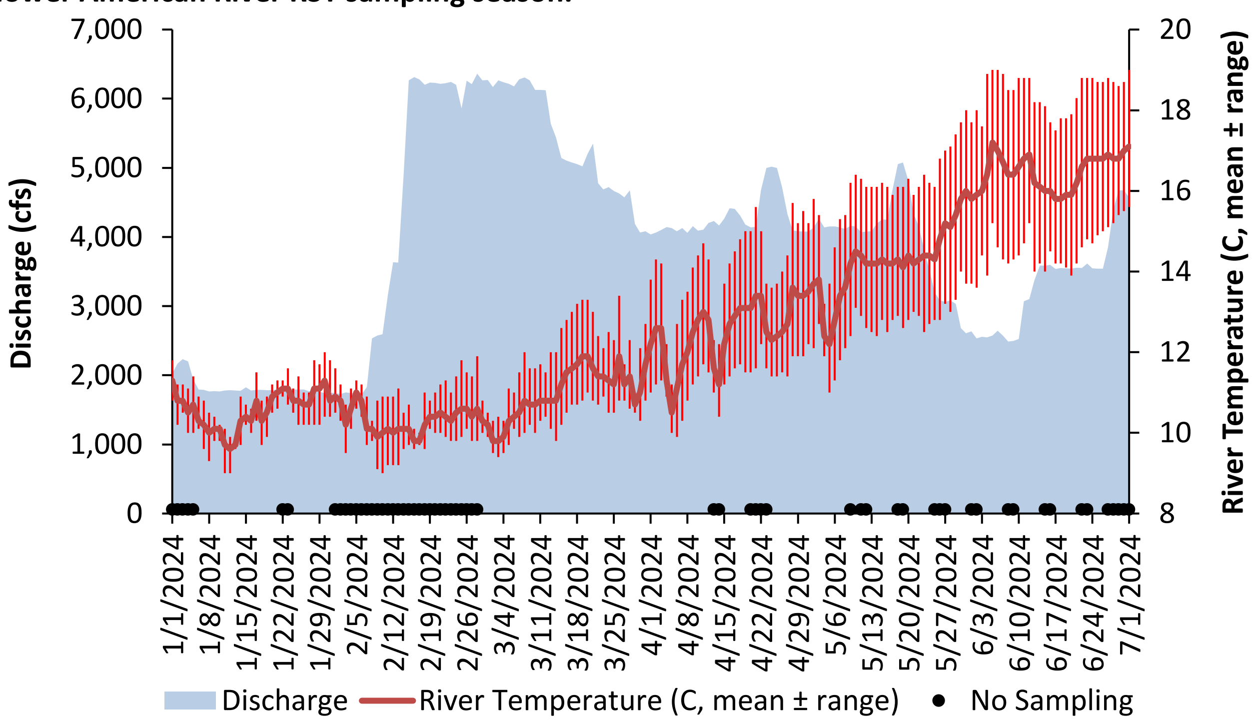

Figure 13: Daily average discharge (cfs) measured at Fair Oaks, and the daily minimum, maximum, and average river temperature (C) measured at Watt Avenue, and dates no sampling occurred during the 2024 lower American River RST sampling season.

Velocity, turbidity, and DO were measured during trap visits throughout the sampling season (Figure 14). Environmental data were not collected between February 1 and February 27 due to backflow up the American River when peaks and troughs in data were expected. Water velocity for Trap 8.1 reached a minimum on February 28, March 2, March 3, and March 5 and a maximum on January 8, January 10, January 15, January 18, and January 20, with a range of 0.6 – 1.4 m/s. Trap 8.2 reached a minimum on March 7 and a maximum on March 25 and May 2 with a range of 0.6 – 1.5 m/s. The mean velocity for Trap 8.1 and Trap 8.2 was similar at 1.03 and 1.15 m/s respectively. The mean velocity for Trap 8.2 is higher than Trap 8.1 likely due to the steeper streambed gradient underneath Trap 8.2. Turbidity for Trap 8.1 reached a minimum on January 15 and a maximum on February 29 with a range of 0.31 – 3.94 NTU. Turbidity for Trap 8.2 reached a minimum on January 26 and a maximum on March 2 with a range of 0.28 – 4.28 NTU. The mean turbidity for Trap 8.1 and Trap 8.2 was similar at 1.64 and 1.53 NTU respectively. The maximum turbidity for Trap 8.1 is slightly higher than Trap 8.2 likely due to Trap 8.1's proximity to an eddy in the northern channel. DO reached a minimum on June 17 and a maximum on February 28 with a range of 8.27 to 11.50 mg/L. DO recorded on May 12, 19, and 27, and June 2, 9, 16, and 23, were higher than expected as the data was recorded in the evenings when DO diurnal patterns are expected to occur.

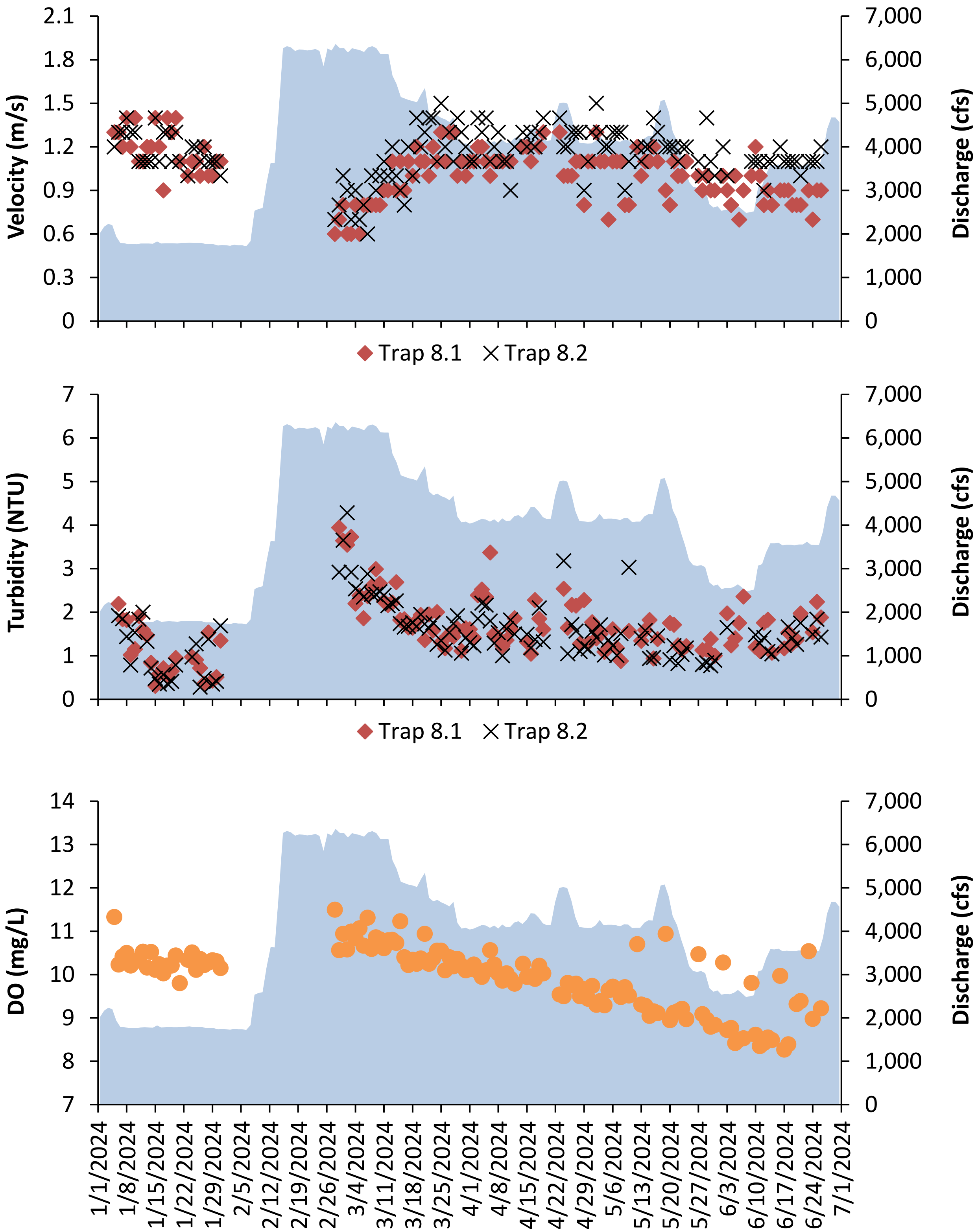

Figure 14: Daily average velocity (m/s) and turbidity (NTU) for both traps, DO (mg/L), and discharge (cfs; measured at Fair Oaks), during the 2024 lower American River RST sampling season.

Catch

The two RSTs deployed during the 2024 sampling season captured 83,376 salmonids presumed to be natural origin, 16 hatchery-produced salmonids, and 238 recaptured Chinook Salmon. The trap furthest from the thalweg, Trap 8.1, captured 48.8% (*n* = 40,833) of these fishes, while Trap 8.2 captured 51.2% (*n* = 42,797). Additionally, 1,973 non-salmonid fishes were captured and identified to at least the family level (Appendix 4).

Fall-run Chinook Salmon

Natural origin fall-run Chinook Salmon encompassed the most of all natural origin fish captured during the 2024 sampling season with 83,196 determined to be fall-run based on results of genetic analysis. Because these fish did not have an adipose fin clip, they were presumed to be of natural origin. Catch of fall-run peaked on January 29, when 12.4% (*n* = 10,307) of these fish were captured (Figure 15). Of all fall-run captured during the 2024 sampling season, 69,865 were classified as unmeasured plus-count tallies.

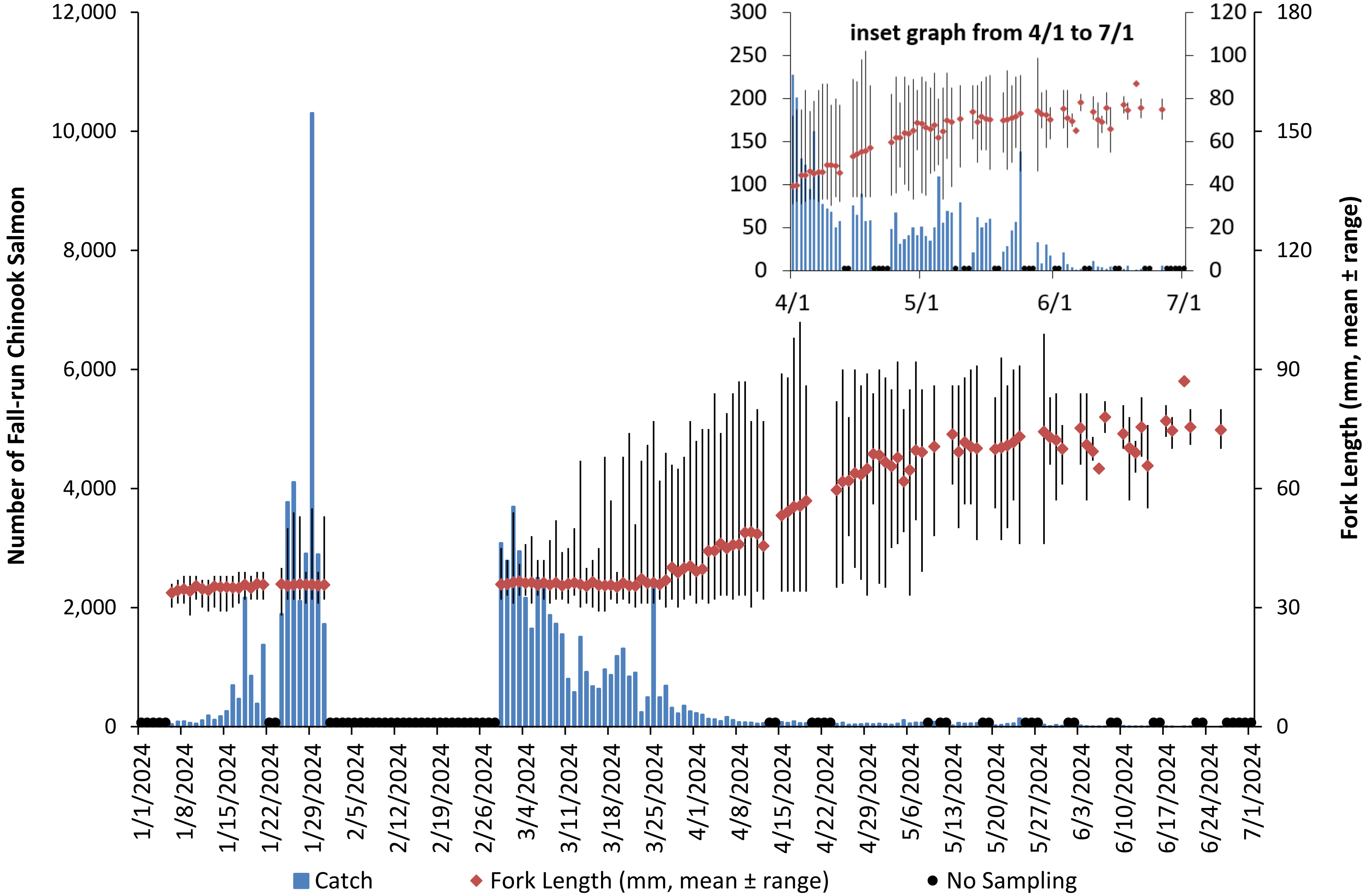

Figure 15: Daily minimum, maximum, and mean fork length (mm) and total catch of natural origin fall-run Chinook Salmon during the 2024 lower American River RST sampling season.

A total of 13,331 natural origin fall-run were measured for fork length (Table 3, Figure 16, and Table 4). The lowest weekly average fork length of 34 mm was seen during the first week of sampling. The smallest natural origin fall-run was 28 mm and was observed on January 9 and January 24. Fork lengths slowly increased throughout the season with the weekly average reaching a maximum of 76 mm the week of June 18. The largest natural origin fall-run was 102 mm and was observed on April 18.

Table 3: Weekly average (Avg), minimum and maximum (Range), and the standard deviation (St. Dev.) of fork lengths (mm) and total weekly catch (n) for natural origin fall-run Chinook Salmon captured during the 2024 lower American River RST sampling season.

Julian Week	Avg	Range	*n*	St. Dev.
1/1 - 1/7	34	(30 – 37)	128	1.44
1/8 - 1/14	35	(28 – 38)	787	1.53
1/15 - 1/21	35	(29 – 39)	6,205	1.36
1/22 - 1/28	36	(28 – 54)	14,790	1.66
1/29 - 2/4	36	(31 – 55)	14,925	1.71
2/5 - 2/11	-	-	-	-
2/12 - 2/18	-	-	-	-
2/19 - 2/25	-	-	-	-
2/26 - 3/4	36	(31 – 54)	14,668	1.72
3/5 - 3/11	36	(31 – 52)	12,514	1.75
3/12 - 3/18	36	(29 – 68)	6,155	2.20
3/19 - 3/25	36	(30 – 77)	7,416	3.45
3/26 - 4/1	39	(30 – 77)	2,553	6.06
4/2 - 4/8	44	(31 – 87)	898	10.53
4/9 - 4/15	49	(30 – 89)	322	11.88
4/16 - 4/22	55	(34 – 102)	268	12.16
4/23 - 4/29	63	(33 – 90)	273	10.89
4/30 - 5/6	65	(33 – 92)	380	9.51
5/7 - 5/13	70	(39 – 92)	236	8.36
5/14 - 5/20	70	(47 – 91)	249	7.54
5/21 - 5/27	72	(46 – 93)	268	8.21
5/28 - 6/3	73	(46 – 99)	109	7.37
6/4 - 6/10	72	(57 – 84)	24	7.36
6/11 - 6/17	70	(55 – 83)	15	8.07
6/18 - 6/24	76	(70 – 87)	8	5.73
6/25 - 7/1	75	(70 – 80)	5	4.87

The subsample of fall-run that were measured for fork length, were also assessed for life stage (Figure 16, Table 4). The majority of these fish were identified as button-up fry and accounted for 79.1% (*n* = 10,551) of the assessed catch. The remaining life stage catch composition consisted of yolk-sac fry (1.5%, *n* = 194), parr (10.1%, *n* = 1,348), silvery parr (9.2%, *n* = 1,226), and smolt (0.1%, *n* = 12). Fall-run Chinook Salmon identified as yolk-sac fry were captured between January 6 and April 10. Button-up fry were captured between January 6 and May 21. Parr were captured between January 26 and June 14, and silvery parr were caught from March 20 through June 26. Lastly, smolt were captured between May 21 and June 26. Average weekly fork lengths generally increased with life stage progression with yolk-sac fry having the lowest average weekly fork length, and smolt with the largest weekly fork length. Fork lengths for the fall-run with life stages identified averaged 33 mm for yolk-sac fry, 36 mm for button-up fry, 54 mm for parr, 73 mm for silvery parr, and 82 mm for smolt (Table 4).

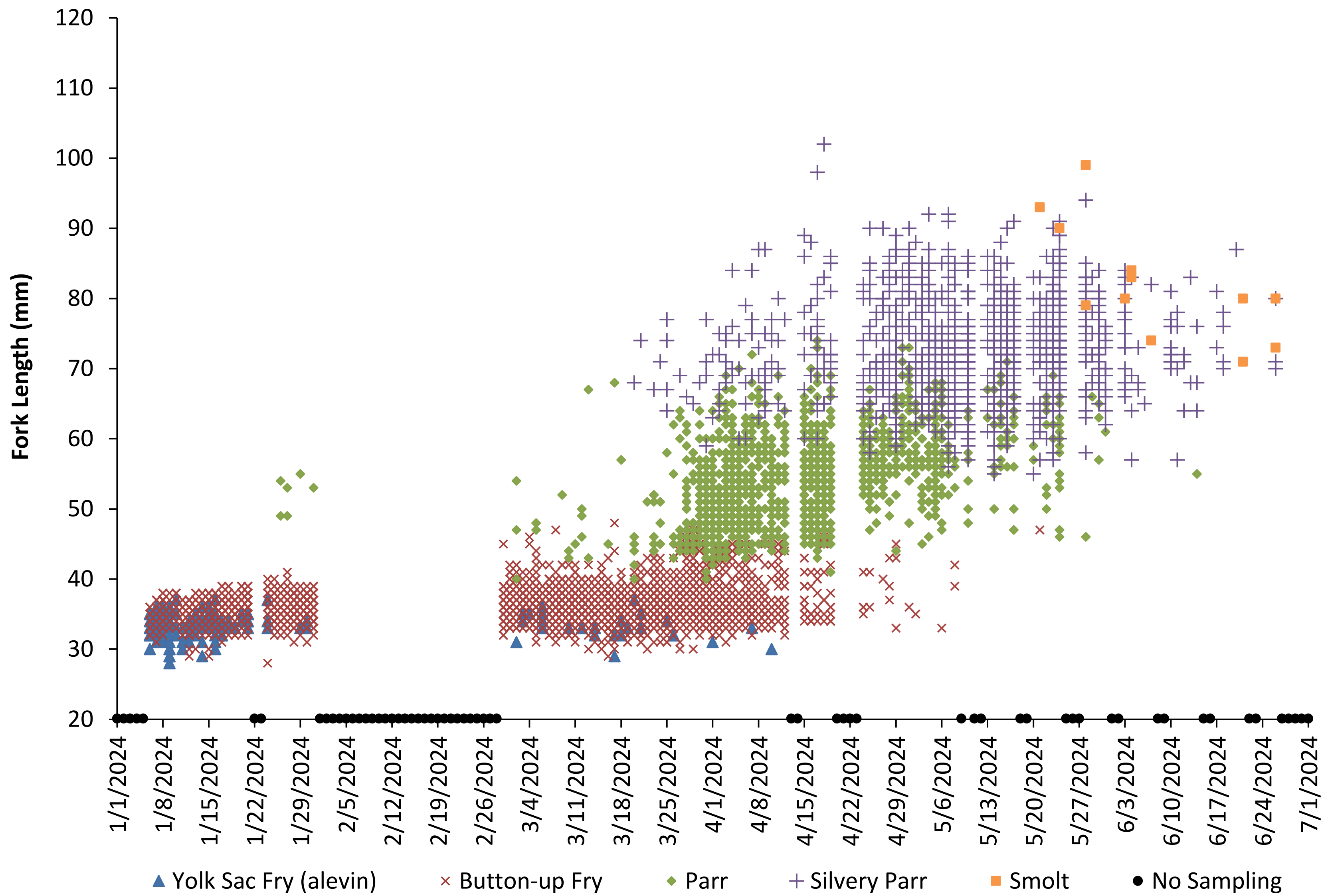

Figure 16: Daily fork length distribution by life stage of natural origin fall-run Chinook Salmon measured and days no sampling occurred during the 2024 lower American River RST sampling season.

Table 4: Weekly average fork length in mm (Avg), minimum and maximum fork lengths (Range), and sample size (n) for each identified life stage of natural origin fall-run Chinook Salmon captured during the 2024 lower American River RST sampling season.

Julian Week	Yolk-sac Fry Avg (Range, *n*)	Button-up Fry Avg (Range, *n*)	Parr Avg (Range, *n*)	Silvery Parr Avg (Range, n)	Smolt Avg (Range, *n*)
1/1 - 1/7	33 (30 - 36, *n* = 40)	34 (31 - 37, *n* = 88)	-	-	-
1/8 - 1/14	33 (28 - 37, *n* = 74)	35 (29 - 38, *n* = 661)	-	-	-
1/15 - 1/21	34 (30 - 37, *n* = 44)	35 (29 - 39, *n* = 1,320)	-	-	-
1/22 - 1/28	35 (33 - 37, *n* = 3)	36 (28 - 41, *n* = 997)	51 (49 - 54, *n* = 4)	-	-
1/29 - 2/4	34 (33 - 34, *n* = 4)	36 (31 - 39, *n* = 596)	54 (53 - 55, *n* = 2)	-	-
2/5 - 2/11	-	-	-	-	-
2/12 - 2/18	-	-	-	-	-
2/19 - 2/25	-	-	-	-	-
2/26 - 3/4	34 (31 - 35, *n* = 4)	36 (32 - 46, *n* = 993)	47 (40 - 54, *n* = 3)	-	-
3/5 - 3/11	34 (33 - 36, *n* = 7)	36 (31 - 47, *n* = 1,387)	46 (43 - 52, *n* = 6)	-	-
3/12 - 3/18	32 (29 - 34, *n* = 8)	36 (29 - 48, *n* = 1,386)	53 (43 - 68, *n* = 8)	-	-
3/19 - 3/25	34 (33 - 37, *n* = 5)	36 (30 - 43, *n* = 1,345)	47 (40 - 58, *n* = 21)	70 (64 - 77, *n* = 8)	-
3/26 - 4/1	32 (31 - 32, *n* = 3)	37 (30 - 47, *n* = 1,114)	50 (40 - 64, *n* = 195)	68 (59 - 77, *n* = 10)	-
4/2 - 4/8	33 (33, *n* = 1)	36 (31 - 45, *n* = 497)	53 (43 - 72, *n* = 331)	71 (60 - 87, *n* = 31)	-
4/9 - 4/15	30 (30, *n* = 1)	37 (32 - 45, *n* = 111)	64 (44 - 69, *n* = 171)	72 (60 - 89, *n* = 30)	-
4/16 - 4/22	-	37 (34 - 46, *n* = 37)	55 (41 - 74, *n* = 182)	74 (60 - 102, *n* = 44)	-
4/23 - 4/29	-	39 (33 - 45, *n* = 13)	57 (44 - 67, *n* = 139)	72 (58 - 90, *n* = 117)	-
4/30 - 5/6	-	35 (33 - 36, *n* = 3)	59 (45 - 73, *n* = 197)	73 (61 - 92, *n* = 179)	-
5/7 - 5/13	-	41 (39 - 42, *n* = 2)	58 (48 - 67, *n* = 21)	72 (56 - 92, *n* = 212)	-
5/14 - 5/20	-	-	60 (47 - 71, *n* = 34)	72 (55 - 91, *n* = 215)	-
5/21 - 5/27	-	47 (47, *n* = 1)	59 (46 - 69, *n* = 27)	74 (57 - 91, *n* = 237)	92 (90 - 93, *n* = 2)
5/28 - 6/3	-	-	60 (46 - 66, *n* = 6)	74 (58 - 94, *n* = 99)	86 (79 - 99, *n* = 3)
6/4 - 6/10	-	-	-	71 (57 - 83, *n* = 21)	80 (74 - 84, *n* = 3)
6/11 - 6/17	-	-	55 (55, *n* = 1)	72 (57 - 83, *n* = 14)	-
6/18 - 6/24	-	-	-	77 (70 - 87, *n* = 6)	76 (71 - 80, *n* = 2)
6/25 - 7/1	-	-	-	74 (70 - 80, *n* = 3)	76 (73 - 80, *n* = 2)
Total	**33 (28 - 37, *n* = 194)**	**36 (28 - 48, *n* = 10,551)**	**54 (40 - 74, *n* = 1,348)**	**73 (55 - 102, *n* = 1,226)**	**82 (71 - 99, *n* = 12)**

Fulton's Condition Factor

Fulton's condition factor (K) for natural origin fall-run Chinook Salmon captured in 2024 was variable across life stages (Figure 17). There were not any significant changes or trends in K. The mean K was 0.91 for button-up fry, 1.00 for parr, 1.08 for silvery parr, and 1.10 for smolt (Figure 18, Appendix 5). Yolk-sac fry captured in 2024 were unable to be accessed for Fulton's condition factor as every fish identified with this life stage measured less than 40 mm and was therefore not weighed.

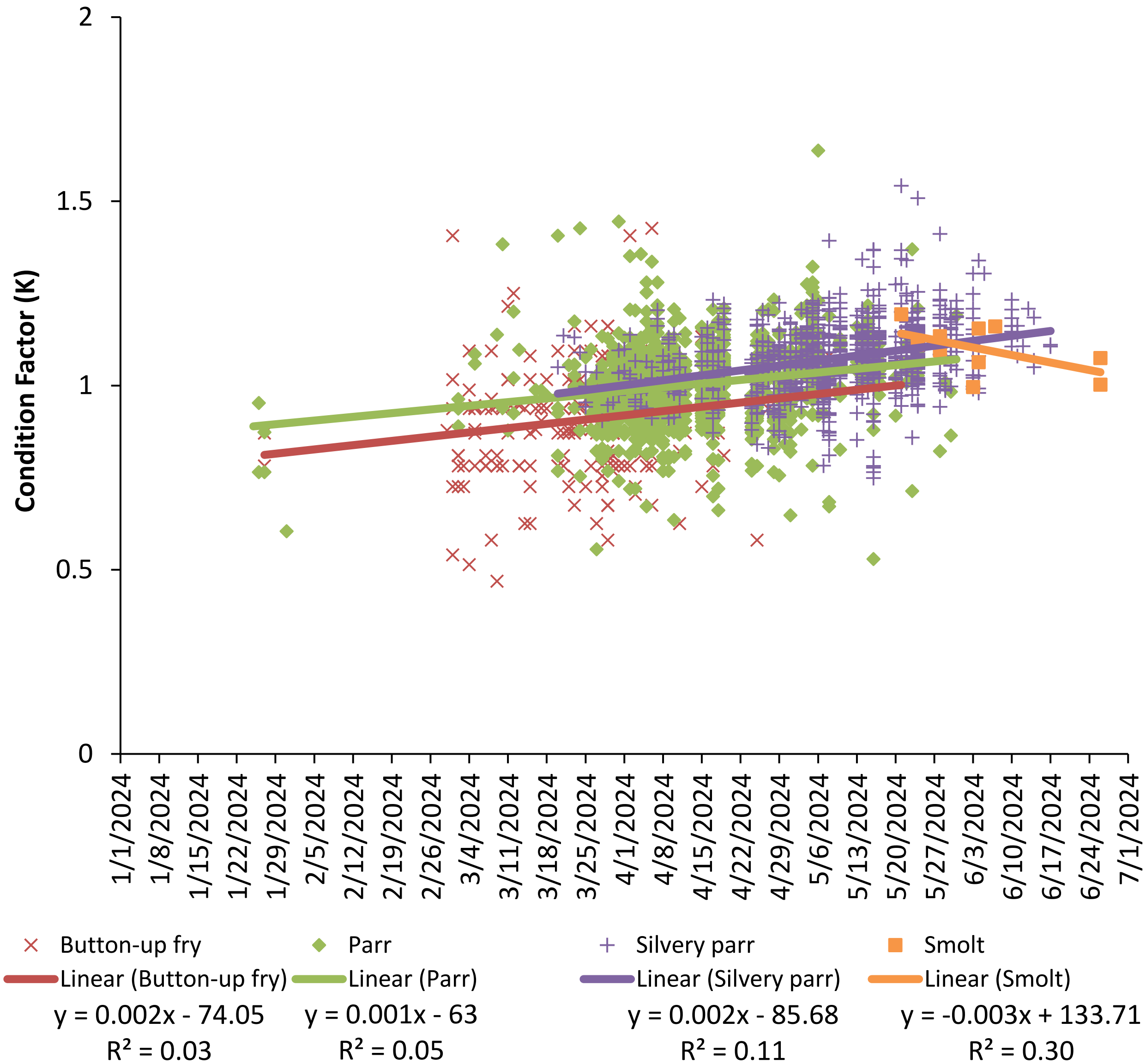

Figure 17: Fulton's condition factor (K) by life stage of fall-run Chinook Salmon during the 2024 lower American River RST sampling season.

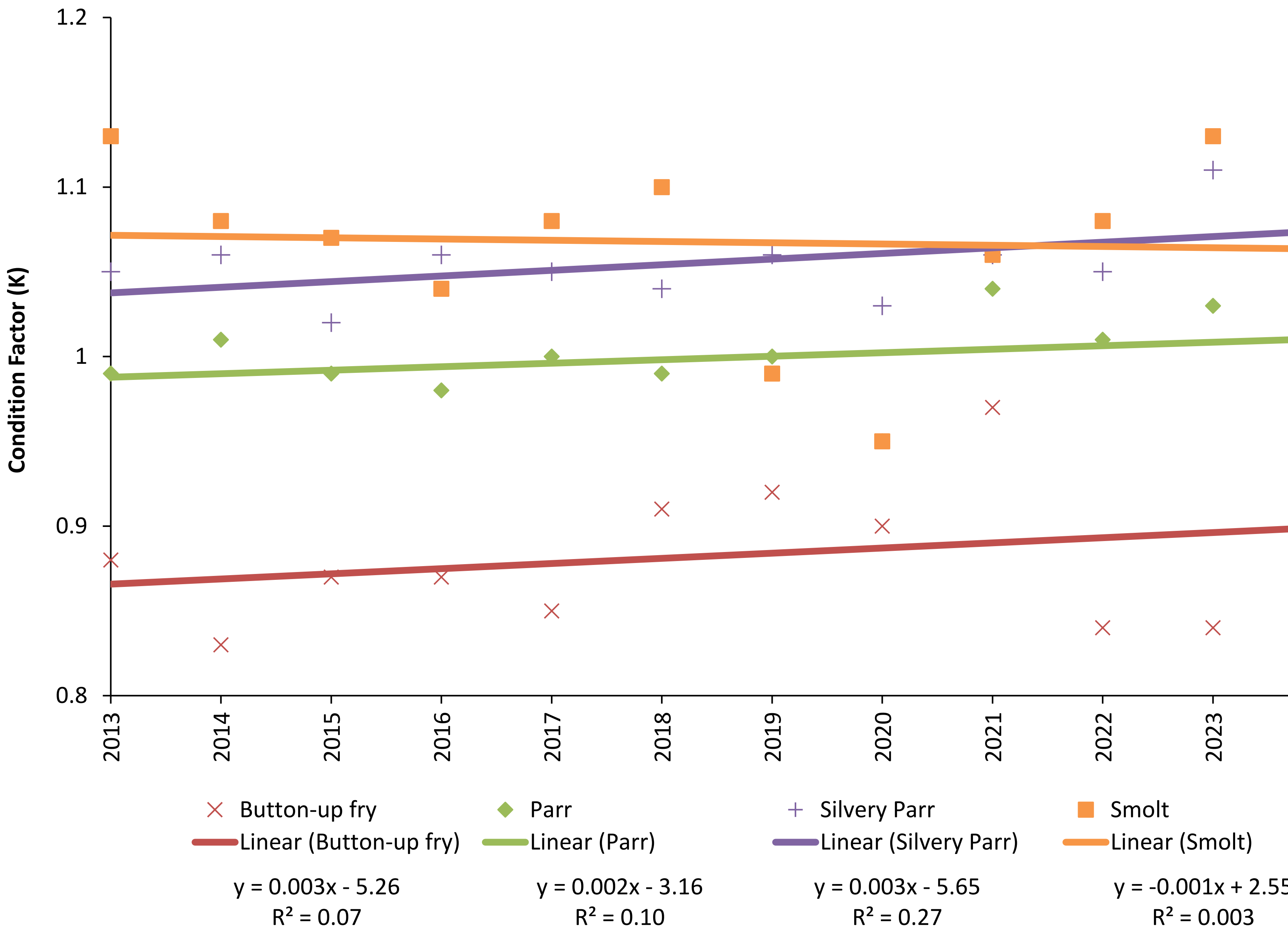

Figure 18: Average Fulton's condition factor by life stage for natural origin fall-run Chinook Salmon from 2013 through 2024.

Trap Efficiency

Seven trap efficiency trials were conducted during the 2024 sampling season, all of which were considered successful (Table 5). The trials used a total of 6,100 fall-run Chinook Salmon. Of these fish, 1,956 were natural origin salmon collected from the RSTs and marked with BBY. The remaining 4,144 were acquired from NFH and marked with BBY or VIE. The average trap efficiency across the seven trials was 2.84% and 1.10% for Trap 8.1 and Trap 8.2 respectively, with a total of 238 marked salmon being recaptured within the trial periods (Table 6). The average fork length of the recaptured fish was approximately the same size as the average fork length of the released fish.

Table 5: Trap efficiency mark, release, and recapture data during the 2024 lower American River RST sampling season.

Date Marked	Fish Origin	Mark Type	Trial Length (days)	Included for Analysis	Release Date	Release Time	Flow (cfs) at Release	Release Avg FL (mm)	Number of Fish Released	Capture Efficiency	Recapture Avg FL (mm)
1/19/2024	Natural	BBY	11	Yes	1/20/2024	16:35	1,800	35	815	8.34%	36
3/20/2024	Natural	BBY	14	Yes	3/21/2024	18:15	5,240	36	1,141	5.61%	36
4/3/2024	Hatchery	BBY	14	Yes	4/4/2024	17:40	4,210	52	721	2.08%	53
4/24/2024	Hatchery	VIE	13	Yes	4/25/2024	18:38	5,090	67	882	1.59%	68
5/1/2024	Hatchery	VIE	14	Yes	5/2/2024	18:51	4,070	71	882	2.95%	73
5/13/2024	Hatchery	VIE	11	Yes	5/13/2024	18:53	4,030	82	844	2.49%	83
5/27/2024	Hatchery	VIE	11	Yes	5/27/2024	19:20	3,080	92	815	3.68%	91

Table 6: Annual trap efficiencies applied for each trap to calculate passage estimates through the CAMP RST Mark-Spline Model for the lower American River RSTs from 2013 through 2024.

Year	Water Year Type	North Channel 8.1	North Channel 8.2	North Channel 5	South Channel 8	South Channel 5
2013	Dry	*4.41%	2.43%	1.18%	1.05%	0.12%
2014	Critical	*11.91%	*8.17%	-	-	-
2015	Critical	8.26%	8.12%	-	-	-
2016	Below Normal	1.49%	1.52%	-	-	0.97%
2017	Wet	0.49%	0.96%	-	-	-
2018	Below Normal	4.77%	3.15%	-	-	-
2019	Wet	0.16%	0.58%	-	-	-
2020	Dry	4.58%	7.66%	-	-	-
2021	Critical	7.06%	4.78%	-	-	-
2022	Critical	10.29%	4.21%	-	-	-
2023	Wet	1.91%	1.21%	-	-	-
2024	Above Normal	2.84%	1.10%	-	-	-

* Indicates that a variable efficiency was applied for that trap for that given year. The value recorded is the average efficiency in that year.

Passage Estimate for Fall-Run Chinook Salmon

Passage estimates were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.

The CAMP RST Platform Mark-Spline Model estimated that 2,775,000 natural origin fall-run Chinook Salmon emigrated past the Watt Avenue RSTs during the 2024 sampling season (95% CI 2,479,000 – 3,086,000; Appendix 6, Figure 19). A flat efficiency rate of 2.84% and 1.10% were applied to Trap 8.1 and Trap 8.2, respectively, to calculate passage as less than 10 trials were conducted during the 2024 sampling season (Table 6). Additionally, the CAMP RST Platform Mark-Spline Model was unable to calculate daily passage between February 1 and February 28 due to no sampling as a result of the Nimbus Steelhead release, storms, and backflow. Because of this break in trap operations in February, the total passage estimate for 2024 is a significant underestimate of total fish passage. Fall-run passage estimates peaked on January 29 when 291,489 were estimated to have emigrated past the RSTs. The cumulative fall-run passage exceeded 95% on March 28 (Figure 20). In the previous 12 years of sampling, the average date catch exceeded 95% was April 25. Appendix 7 provides daily passage estimates from 2013 to 2024, while Figure 21 offers annual passage estimates by life stage for the same period.

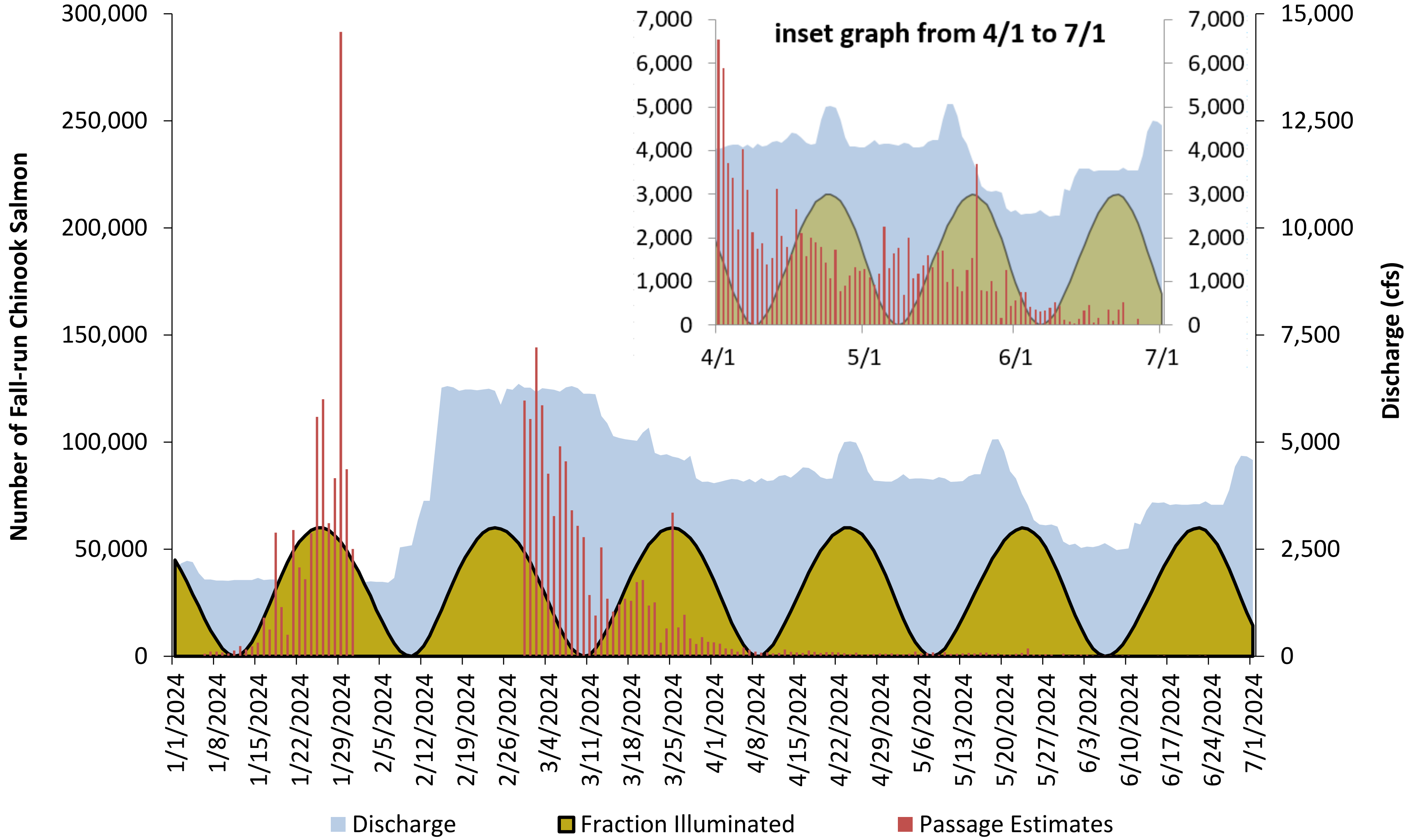

Figure 19: Daily passage estimate of natural origin fall-run Chinook Salmon calculated through the CAMP RST Mark-Spline Model, fraction illuminated, and daily average discharge at Fair Oaks during the 2024 lower American River RST sampling season.

Passage estimates in this figure were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.

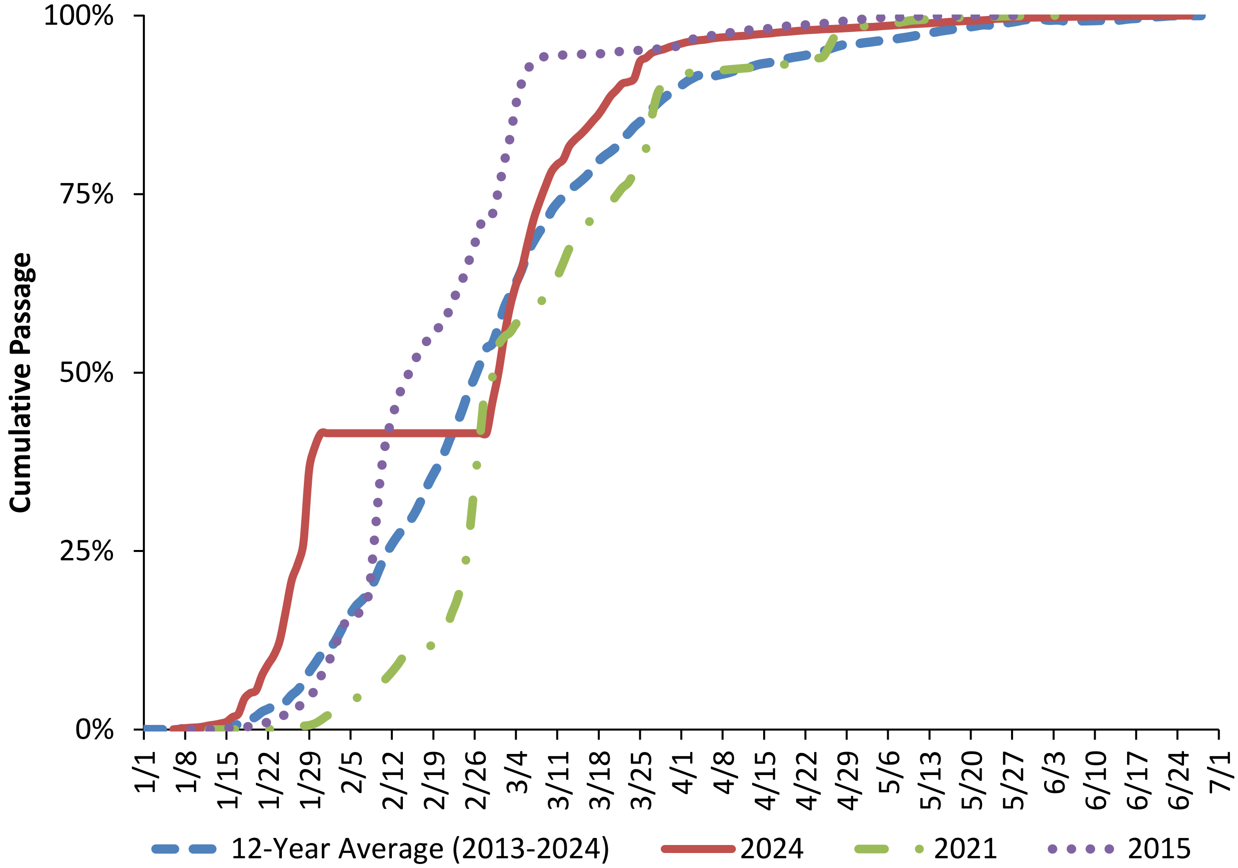

Figure 20: Cumulative passage estimates of natural origin fall-run Chinook Salmon calculated through the CAMP RST Mark-Spline Model at the lower American River RST from 2013 through 2024.

Passage estimates in this figure were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.

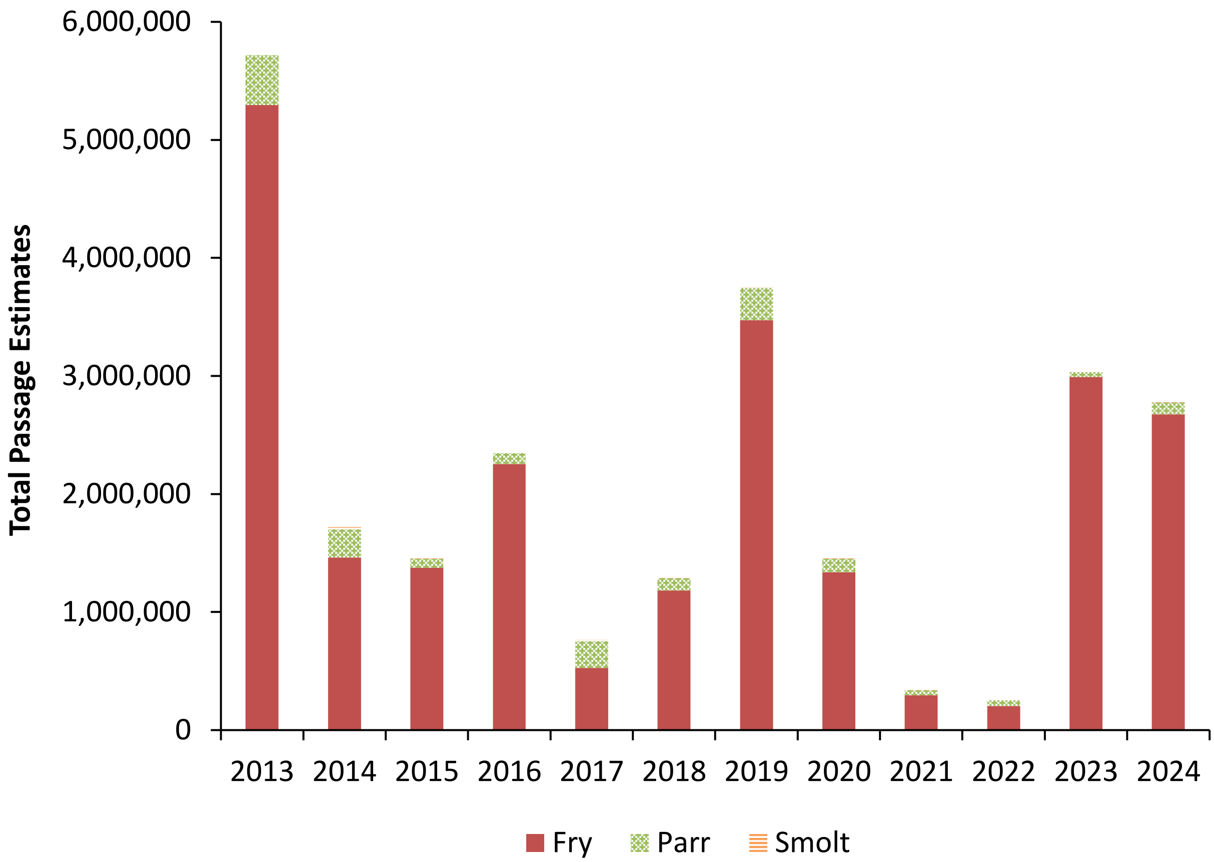

Figure 21: Annual fall-run Chinook Salmon passage estimates by life stage calculated through the CAMP RST Mark-Spline Model for the lower American River RSTs from 2013 through 2024.

Passage estimates in this figure were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.

Genetic Analysis

Natural Origin Chinook Salmon

A total of 63 genetic samples were taken from adipose intact Chinook Salmon (13 LAD fall-run, 1 LAD late fall-run, 37 LAD spring-run, and 12 LAD winter-run) and analyzed using SNP genetic markers to determine final run assignments (Table 7, Figure 22, Appendix 8). Because these salmon had an intact adipose fin, the salmon were presumed to be of natural origin. The SNP panel's probabilities of the samples exceeded the 50 percent threshold for 59 samples and the corresponding run assignments for salmon were assigned based on genetic analysis. The remaining 4 samples were classified as "no call" and were not able to be identified to a specific run through SNP genetic markers.

A total of 83,068 natural origin Chinook Salmon captured were classified as fall-run using the LAD criteria. Genetic samples were collected from 13 LAD fall-run throughout the 2024 sampling season. Analyses using SNP genetic markers for these samples indicated that 100% (*n* = 13) of these individuals were fall-run (Table 7). Because the LAD criteria continued to be highly accurate when assigning this run, a final run assignment of fall was applied to the remaining 83,055 LAD fall-run that were not genetically sampled.

A total of 88 natural origin Chinook Salmon captured were classified as late fall-run using the LAD criteria. Genetic samples were collected from 1 LAD late fall-run throughout the 2024 sampling season. Analyses using SNP genetic markers for these samples indicated that 100% (*n* = 1) of these individuals were fall-run (Table 7). Because the LAD criteria appeared to incorrectly assign this run, the remaining 87 of the LAD late fall-run that were not genetically sampled were given a final run assignment of fall-run.

A total of 41 natural origin Chinook Salmon captured were classified as spring-run using the LAD criteria. Genetic samples were collected from 37 of the 41 LAD spring-run throughout the 2024 sampling season. Analyses using SNP genetic markers for these samples indicated that 94.6% (*n* = 35) of these individuals were fall-run, 2.7% (*n* = 1) was a winter-run, and 2.7% (*n* = 1) was a "no call" (Table 7). Because the LAD criteria appeared to incorrectly assign this run for all these individuals, the remaining 4 of the LAD spring-run that were not genetically sampled and the 1 "no call" were given a final run assignment of fall-run.

A total of 12 natural origin Chinook Salmon captured were classified as winter-run using the LAD criteria. Genetic samples were collected from all 12 of the LAD winter-run throughout the 2024 sampling season. Analyses using SNP genetic markers for these samples indicated that 75.0% (*n* = 9) of these individuals were winter-run and 25.0% (*n* = 3) were "no call" (Table 7). Because the LAD criteria appeared to correctly assign this run for these individuals, the 3 "no call" were given a final run assignment of winter-run.

Table 7: Comparison of natural origin Chinook Salmon run assignments using LAD criteria and SNP genetic markers.

	SNP Confirmed Fall Run	SNP Confirmed Late Fall Run	SNP Confirmed Spring Run	SNP Confirmed Winter Run	No Call
LAD Fall	13	0	0	0	0
LAD Late Fall	1	0	0	0	0
LAD Spring	35	0	0	1	1
LAD Winter	0	0	0	9	3

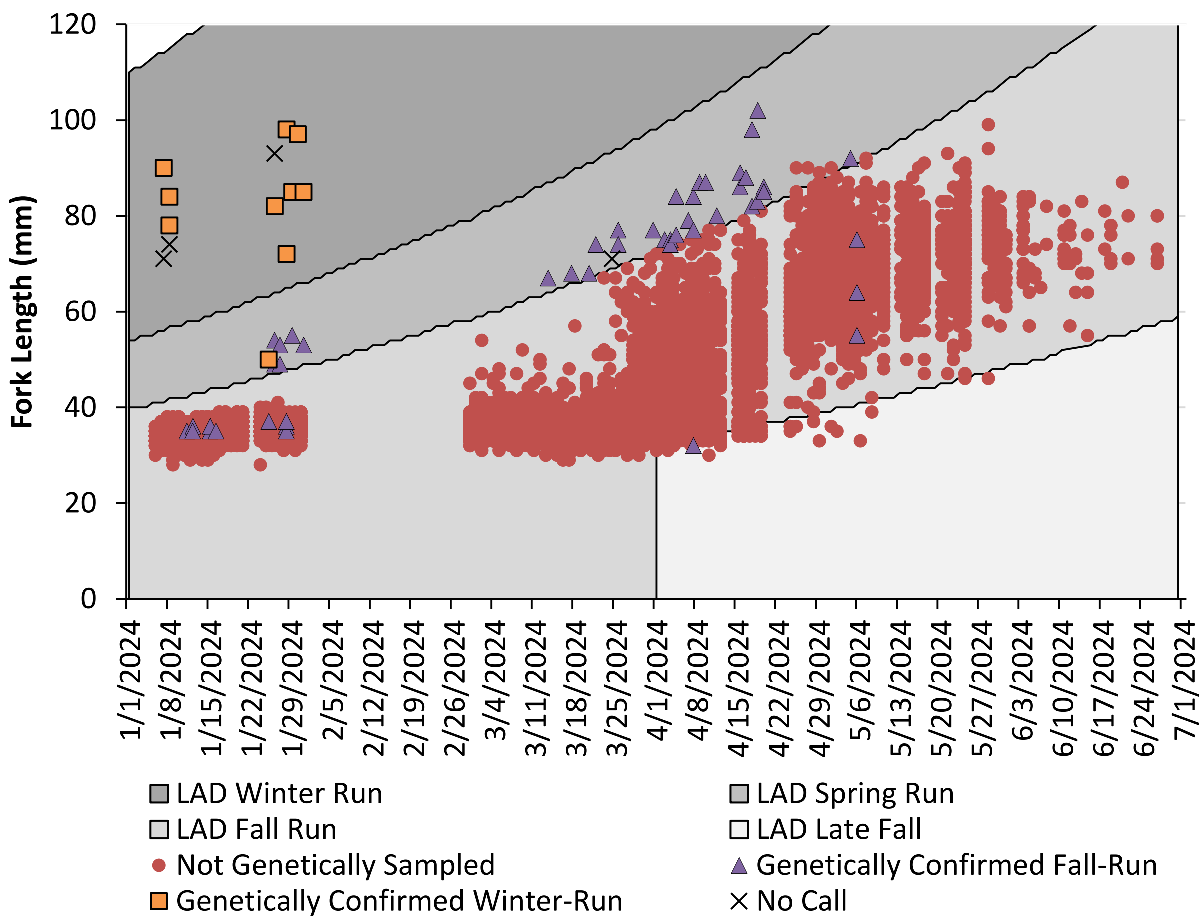

Figure 22: Daily fork length distribution of SNP genetically and not genetically sampled natural origin Chinook Salmon measured during the 2024 lower American River RST sampling season.

Hatchery Origin Chinook Salmon

Two adipose clipped Chinook Salmon were captured during the 2024 sampling season. Because these salmon had a clipped adipose fin, the salmon were classified as hatchery origin. The first salmon was captured on January 26. A genetic sample was collected from this salmon and analyzed using SNP genetic markers (Appendix 8). Analyses using SNP genetic markers for this sample indicated that this individual was a winter-run. Additionally, the coded wire tag was extracted and indicated that it was a part of the Livingston Stone Hatchery Winter-Run release on December 22, 2023. Because of this, this salmon was given a final run assignment of winter-run. The second salmon was captured on April 28. No genetic samples were collected from this fish, however, because this fish was captured shortly after the NFH release of 841,000 fall-run Chinook Salmon at approximately 90 mm, and its fork length was similar (85 mm), it is presumed that this fish was a part of this release and given a final run assignment of fall-run.

Spring-run and Winter-run Chinook Salmon

Genetic analyses suggested that 13 natural origin winter-run and no natural origin spring-run Chinook Salmon were captured during the 2024 sampling season. Nine genetically confirmed winter-run were captured between January 7 and January 31 and measured within the LAD winter-run fork length range of 57 to 134 mm. The average fork length for these fish was 86 mm with a range of 72 to 98 mm. One genetically confirmed winter-run was captured on January 25 and its fork length measured 50 mm which was in the LAD spring-run fork length range of 48 to 63 mm (Figure 22).

Steelhead

A total of 167 natural origin steelhead were captured during the 2024 sampling season. Catch peaked on March 13 and March 15, comprising 4.8% (n = 8) of the total natural origin steelhead captured (Figure 23). The majority of captured steelhead were assessed for life stage. The life stage composition consisted of 1 yolk-sac fry, 109 button-up fry, 52 parr, 2 silvery parr, and 3 that were not assigned a life stage. Fork lengths ranged from 22 mm for yolk-sac fry, 21 – 44 mm for button-up fry, 42 – 77 mm for parr, and 89 – 99 mm for the silvery parr (Figure 24). Cumulative catch of natural origin steelhead exceeded 95% on June 13 (Figure 25).

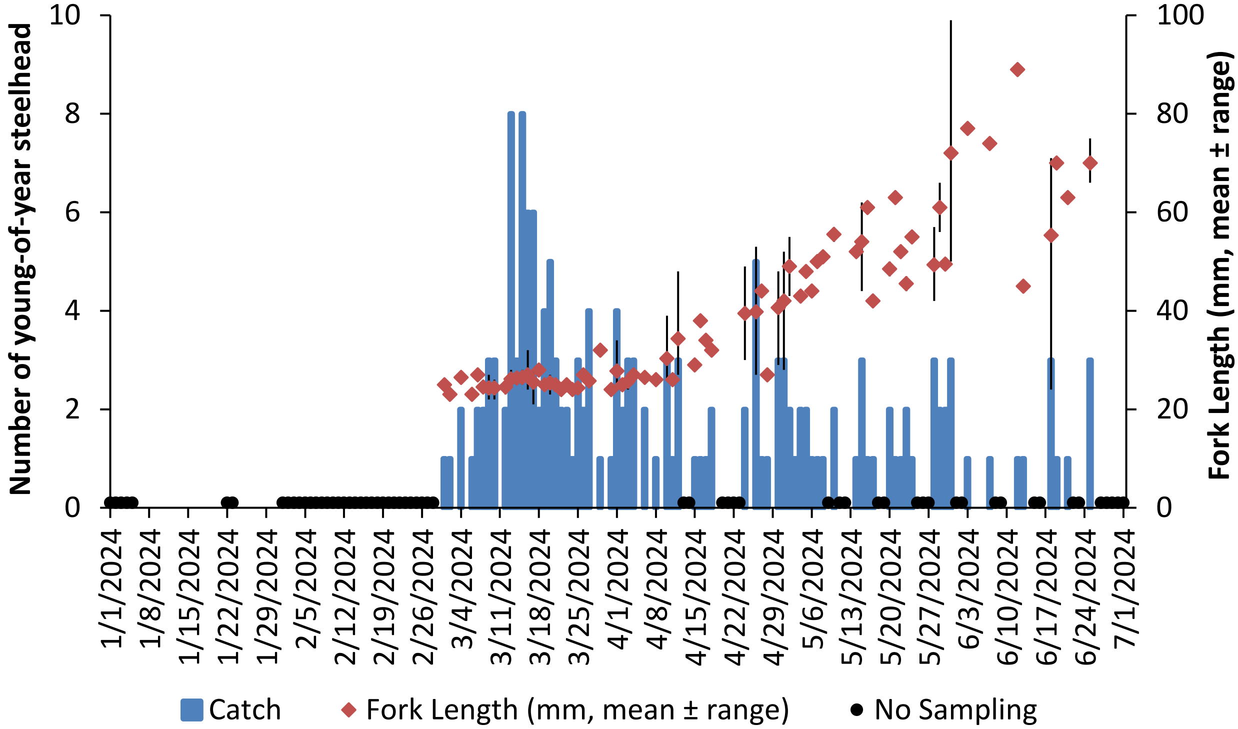

Figure 23: Daily minimum, maximum, and average fork length (mm) and catch distribution of natural origin young-of-year steelhead captured during the 2024 lower American River RST sampling season.

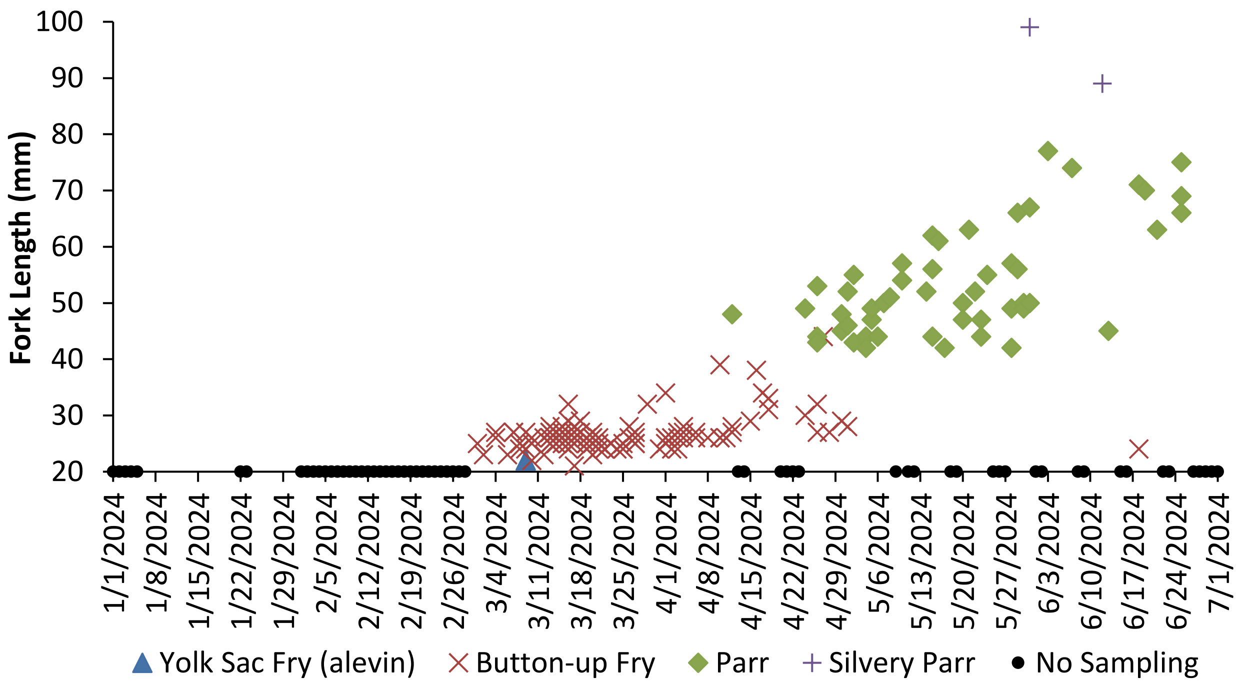

Figure 24: Daily fork length distribution by life stage of natural origin young-of-year steelhead measured and days no sampling occurred during the 2024 lower American River RST sampling season.

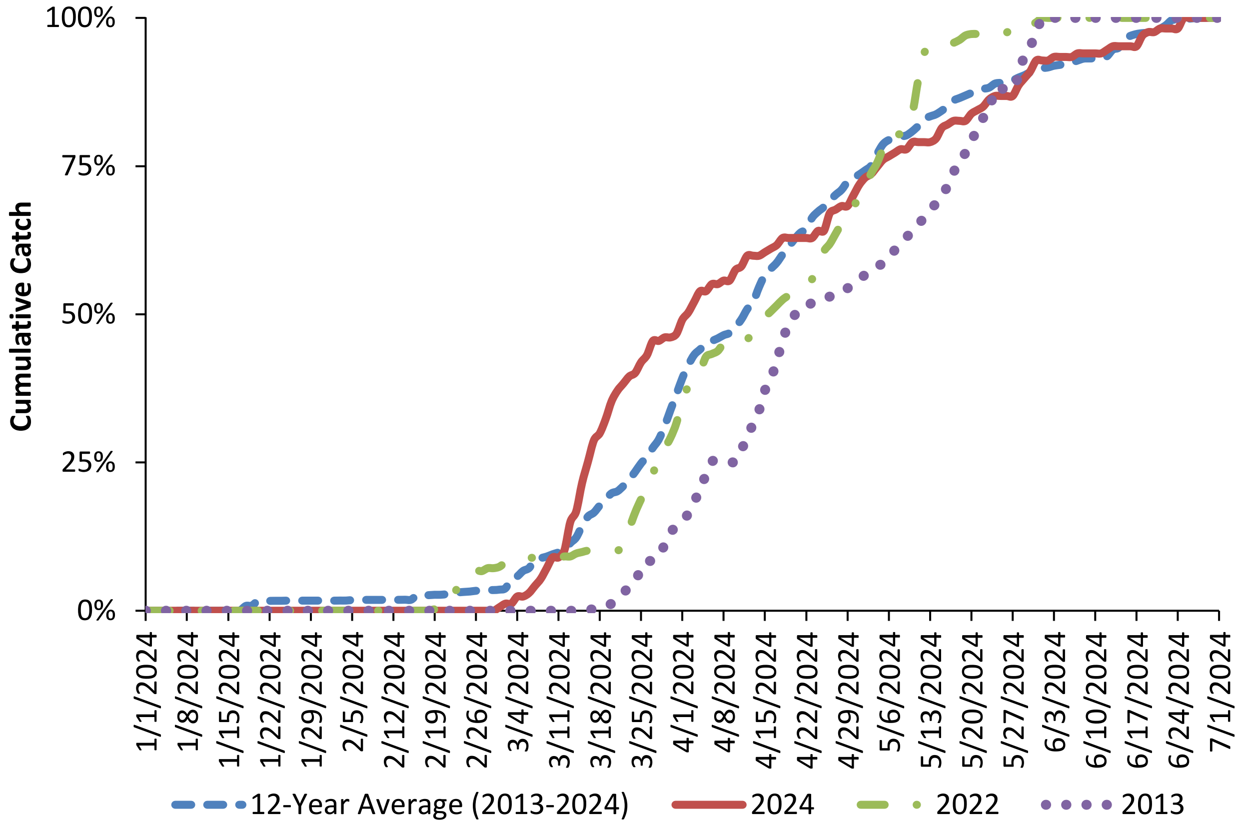

Figure 25: Cumulative catch of natural origin steelhead at the lower American River RST from 2013 through 2024.

In addition to the natural origin steelhead catch, 14 adipose clipped hatchery origin steelhead were also captured. Three of the 14 steelhead were classified as adults and were captured on January 13, January 21, and January 31. These fish were not measured for fork length since they were greater than the length of available measuring boards, but all were estimated to be greater than 700 mm. The remaining 11 adipose clipped steelhead were captured between March 20 and June 25 following the NFH steelhead release, with an average fork length of 247 mm (range: 132 – 360 mm). Daily catch peaked on March 29 and April 6 (*n* = 2).

Non-salmonid Species

A total of 1,973 non-salmonid fish were captured during the 2024 sampling season. The majority (*n* = 1,604, 81%) of these fish belonged to 22 identified species in the following families: Catostomidae (suckers), Centrarchidae (sunfish), Clupeidae (shad), Cottidae (sculpins), Cyprinidae (minnows), Embiotocidae (Tule Perch), Gasterosteidae (sticklebacks), Ictaluridae (catfish), Moronidae (Striped Bass), Osmeridae (smelts), Petromyzontidae (northern lampreys), and Poeciliidae (mosquitofish; Figure 26). The remaining 19% (*n* = 369) were not able to be identified to species level, but belonged to the following families: Centrarchidae (*n* = 128), Cottidae (n = 7), Cyprinidae (n = 8), and Petromyzontidae (n = 226). Most non-salmonid fish captured were native to the Central Valley watershed (n = 1,728, 88%) with the remaining individuals (n = 245, 12%) being non-native species. Appendix 9 contains a complete list of non-salmonid species captured by month during the 2024 sampling season.

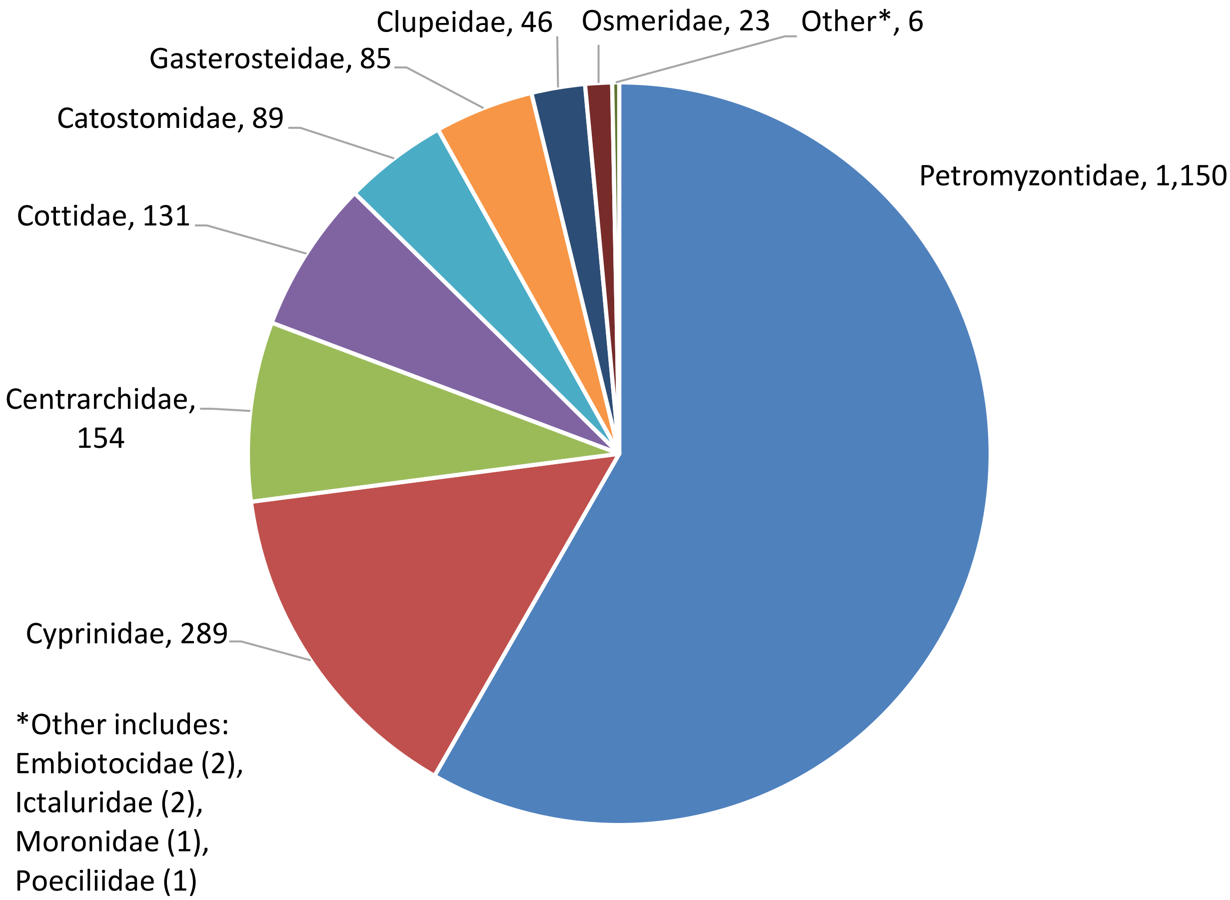

Figure 26: Non-salmonid catch totals for each family of species collected during the 2024 lower American River RST sampling season.

Of the 1,973 non-salmonid fish captured, 1,150 (58%) were identified as Petromyzontidae spp. (northern lampreys); 911 (46%) of which were identified as Pacific Lamprey, consisting of 2 adults and 909 juveniles; 13 (1%) were identified as River Lamprey. The remaining 226 (11%) captured were identified as Petromyzontidae ammocoetes and were not identified to a species level. Catch of Pacific Lamprey macropthalmia peaked on January 21 when 48 (5%) of the total Pacific Lamprey were captured. Catch of River Lamprey peaked on January 31 when 3 (23%) of the total was captured. Catch of ammocoetes peaked on April 6 when 15 (7%) of the total was captured. (Figure 27).

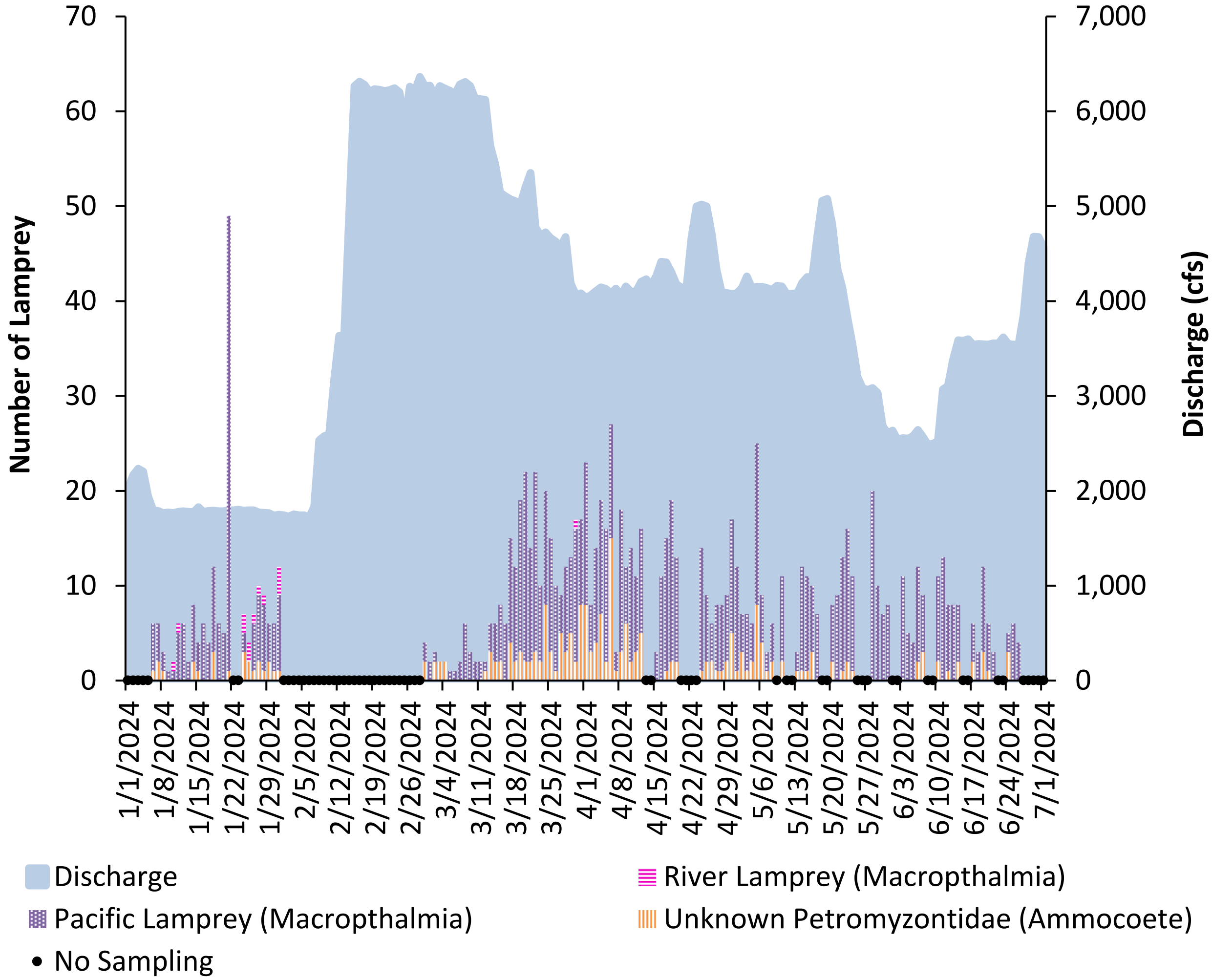

Figure 27: Daily lamprey catch, daily average discharge (cfs) measured at Fair Oaks, and dates no sampling occurred during the 2024 lower American River RST sampling season.

Discussion

Project Scope

The continued operation of the lower American River RSTs during the 2024 sampling season provided valuable biological monitoring data for emigrating juvenile Chinook Salmon and steelhead. Primary objectives of the study were met by collecting data that can be used to estimate passage of fall-run Chinook Salmon and accurately quantifying catch of steelhead, spring-run, and winter-run Chinook Salmon. Secondary objectives were met by collecting biological data from captured salmonids that can be used to determine how populations respond to various environmental parameters. This data will continue to strengthen the understanding of lower American River salmonids by expanding on findings from previous CDFW emigration surveys (1992-2012) and PSMFC RST emigration surveys (2013-2023).

Water Year Type

The California Department of Water Resources' Sacramento Valley Water Year Hydrologic Classification Indices indicate that 2024 was an "Above Normal" water year type. The 2024 water year was characterized by a mix of variability and uncertainty. California's Central Valley experienced elevated air temperatures throughout the year with noticeable differences from historic averages. Specifically, air temperatures between January and March were warmer than usual, and contributed to an unusually mild winter, whereas recorded air temperatures in April through June were significantly above historic averages. The year also started with a significant wet period in late January and early February, leading to substantial snowpack and reservoir replenishment in the early winter months. Consequently, Keswick and Oroville Dams, located on the Sacramento and Feather Rivers respectively, were actively managing water releases in the preceding months for flood control and water storage management purposes. Though major flood control releases were occurring on the Sacramento and Feather Rivers, the American River had more storage available and experienced fewer high-volume flood control releases during the early winter months. Consequently, due to the differences in magnitude of Sacramento and American River releases, Sacramento River water backflooded into the American River. This backflood period was observed at the Watt Avenue RST site in 2024 and had been previously noted in 2015 and 2019 (PSMFC 2015 and PSMFC 2019). Ultimately, this resulted in an extended gap in sampling that had not been experienced since 2019, resulting in a low total passage estimate as passage estimates could not be calculated for a significant number of days during this gap in sampling (PSMFC 2019).

Catch and Passage Estimates

Raw Catch

Several factors must be considered when interpreting catch of fall-run, spring-run, and winter-run Chinook Salmon and the quantity of steelhead during the 2024 sampling season. Due to the consistent and mild flows experienced on the lower American River in early January, the RSTs were safely installed on January 5 with the RST sampling season beginning January 6. This marks the earliest the RSTs have been operated on the lower American River since at least 2013. Through the first seven days of sampling a total of 626 fall-run were captured accounting for 0.8% of the total fall-run catch, suggesting that the sampling season encompassed the majority of the start of the juvenile salmonid emigration period. Due to the higher river releases at the end of the 2024 sampling season, the RSTs were able to be operated until June 26, which is the second latest the RSTs have been operated by PSMFC in a sampling season (PSMFC 2013 - 2023). Through the last seven days of sampling, a total of 13 fall-run were captured accounting for 0.02% of the total fall-run catch. When interpreting whether the sampling season encompassed the end of the juvenile salmonid emigration period, it is likely that the end of the salmonid emigration period was sampled.

The lower American RSTs experienced largely successful trap operations when the traps were sampling similar to previous sampling seasons (PSMFC 2013 -2023). The RSTs were only stopped on a few occasions between sampling visits (Figure 10, Figure 11), bringing stronger confidence and consistency in data collected. Contrarily, consistent sampling was limited with 52 of 173 days (30%) not sampled due to reasons including: suspending sampling for backflow (23 days), weekend shutdowns (15 days), NFH salmonid releases (9 days), and storms (5 days).

Throughout February and into mid-March, backflow on the American River caused significant operational issues that impacted raw catch numbers (Figure 12, Appendix 2). Backflow poses several problems for monitoring juvenile salmonids. These include elevated river height and reduced in-river flow, which can cause RST operational and environmental issues such as minimal cone spinning and an inability for the RSTs to filter debris into the live well, leading to high mortality rates. Additionally, Chinook Salmon could be recaptured multiple times without knowledge or there could be capture of other non-natal Chinook Salmon temporarily rearing the American River. Trap efficiencies were likely impacted as well, given the documented correlation between discharge and trap efficiency (Appendix 10). Evidently, the RSTs were offline for backflow beginning February 6 and were not operated again until February 29 when backflow issues were able to be managed, though the river did not appear to return to its normal state until around March 18 (Figure 12). Overall, this backflow period heavily impacted raw catch and passage estimate totals during the period of peak fall-run emigration.

The NFH conducted four in-river releases of hatchery salmonids during the sampling season, which impacted raw catch totals. The NFH steelhead release occurred first between January 31 and February 2 with 516,000 fish released, which followed the constant fractional marking rate of 100%. Following this release, the NFH conducted two in-river releases on February 12 and February 20 as a part of the parentage-based tagging study with a total of approximately 2.4 million (approximately 1.2 million per release) hatchery fall-run Chinook Salmon released at the NFH. The released fish average fork length was 35 mm and did not contain any marks to indicate origin (i.e., adipose clip). Because these fish were approximately the same size as the natural origin fall-run and did not display any marks to indicate origin, it made identifying between natural and hatchery origin fall-run impossible in the field, biasing natural origin fall-run catch totals high. However, 871 fin clips were collected throughout the sampling season to help distinguish between natural and hatchery origin fall-run catch for this release. The results are currently pending, but will help determine how quickly the released hatchery origin fall-run Chinook Salmon of this size migrate past the lower American River RSTs following release. The last in-river release occurred on April 19, when approximately 841,000 hatchery fall-run Chinook Salmon were released at the Sunrise Boat Launch. The released fish average fork length was 90 mm and contained an adipose clip rate of 25%. Contrary to the February hatchery release, the average fork length of the released fish fell within the LAD spring-run boundary (83 to 111 mm on April 19). As a result, the RSTs were taken out of service beginning April 20 to avoid misclassification. Sampling resumed on April 24, representing the first date hatchery Chinook Salmon from this release could have been captured. However, only one adipose clipped Chinook Salmon was captured once sampling resumed. Additionally, in previous years, released hatchery Chinook Salmon in this size class tended to migrate past the lower American River RSTs as quickly as four days following release (PSMFC 2020). Evidently, though some hatchery fall-run could have been captured, it does not appear that the April release significantly impacted fall-run catch totals.

Efficiency Trials

Fall run passage estimates are also dependent on the quantity and quality of trap efficiency trials. Seven efficiency trials were conducted during the sampling season and all seven efficiency trials were included in data analysis for the estimation of fall-run passage. Efficiency trials during the sampling season were typically conducted every two weeks, the minimum time between efficiency trials using BBY, when consistent sampling occurred. All efficiency trials had a release group of at least 700 fall-run with double digit recaptures occurring for every trial, suggesting adequate sample sizes (Table 5). Additionally, most recaptured fall-run occurred within four days after they were released (n = 235, 98.7%). Trap operations were largely successful in those four days following release, consistent with previous sampling seasons, with one Trap 8.1 stoppage occurring in trial one on January 21 and in trial four on April 28 (PSMFC 2013 - 2023). Additionally, during trial one, sampling was ceased on

January 22 and briefly on January 23 due to a storm and associated heavy debris loads. However, because the trap efficiency was close to its expected value, the trial was included for data analysis and fall-run passage estimation.

Effective efficiency trials are also dependent upon adequate and stable flow during the entirety of the efficiency trial period (USFWS 2008). The ideal velocity of 1.5 m/s for 8-foot RSTs is occasionally seen on the lower American River and was observed on a handful of occasions in 2024 with velocity averaging 1.1 m/s with a range of 0.6 – 1.5 m/s (USFWS 2008). Flows remained relatively stable throughout the duration of each trap efficiency trial (Figure 13, Table 5). The efficiency trials also occurred at nearly every flow level seen on the lower American River during the 2024 sampling season, with results close to previous trials, bringing higher confidence to the 2024 efficiency trial dataset (Table 5, Appendix 10).

Overall, the capture efficiencies during the two trials in January and March averaged 7.0% (range: 5.6 – 8.3%), while the last five trials in April and May averaged 2.6% (range: 1.6 – 3.7%). The decrease in capture efficiency between these trials could be explained by the increase in discharge, as seen in previous sampling seasons (PSMFC 2013 – 2023). This decrease in efficiency is likely because the north channel carries a smaller proportion of the water volume with an increase in flow, thus causing the RSTs to fish a smaller proportion of the river (Appendix 1, Appendix 10). An increase in average release fork length could have also contributed to the lower capture efficiency due to trap avoidance of larger fish (Johnson et al. 2007), but did not appear as impactful as the higher discharge.

Passage Estimates

The enhanced efficiency model developed by West Inc. was previously used to calculate passage estimates from 2019 to 2022. However, use of this model was discontinued as there were concerns with the model's developing accuracy issues. There is currently an effort underway to develop a new efficiency model that will factor in various environmental covariates and previous efficiency trials as the previous model intended. Meanwhile, the previous CAMP RST Platform Mark-Spline Model that was used from 2013 to 2018 to calculate passage estimates was used again and re-ran for the 2019 to 2024 sampling seasons to allow for more meaningful annual comparisons.

The CAMP RST Platform Mark-Spline Model is a simpler model that only uses efficiency trials conducted in a given sampling season to calculate passage estimates. A limiting factor with this model is that when less than 10 trials are conducted in a given sampling season, a flat efficiency rate is applied. Other than in 2013 and 2014, this model has only used flat efficiency rates when calculating passage estimates for the lower American River RSTs (Table 6). Because of this, it is important that when these flat efficiency rates are applied in that given sampling season that the efficiency trials are conducted frequently, consistently, and are representative of all environmental conditions experienced in that given season. For sampling seasons that experience highly variable environmental conditions (e.g. discharge, turbidity, ect.) and struggle with consistent sampling, passage estimates calculated with this model can be high problematic and misrepresentative. Specifically for the lower American River RSTs, the relationship between discharge and trap efficiency is highly correlated, so this model works best when the American River is at a consistent flow rate (Appendix 10).

There are a few concerns with the CAMP RST Platform Mark-Spline Model for passage estimates calculated for the 2024 sampling season. Firstly, in February, there was a large gap in sampling due to backflow from the Sacramento River up the American River. Sampling was ceased during this time, and because the model cannot calculate an imputed catch for gaps in sampling greater than 7 days, no passage estimates were calculated for February 2024 (Appendix 7). The month of February is historically known for its high peaks in passage, so ultimately, missing sampling in this month understimated the overall passage estimate for 2024. Secondly, because a flat efficiency rate was applied to each trap, it likely that passage estimates for the fry life stage were overestimated, and underestimated for the parr and smolt life stages (Table 5). Because the majority of fish that migrate past the traps as fry, it is likely that this would bias the overall passage estimate high. However, though there was a large gap in sampling during the 2024 sampling season, seven efficiency trials were conducted and showed trap efficiencies consistent to previous sampling seasons. Specifically, the correlation between discharge and trap efficiency continued to strengthen, and when the new model that uses environmental covariates and previous efficiency trials is developed, this data will help passage estimates become more accurate and consistent.

Comparing passage estimates calculated in previous sampling seasons, there does appear to be a relationship between water year type and total passage. Typically, in wet to above normal water year types, passage estimates are generally higher (Appendix 6). This is likely because the increased river flow provides more habitat and food availability, while also mitigating predation. However, in previous wet year types, there have been problems maintaining consistent sampling at the Watt Avenue RSTs for a multitude of reasons, not allowing passage estimates to be calculated for the entirety of the sampling season (Appendix 7). Contrarily, in below normal to critical water year types, passage estimates are generally lower (Appendix 6). This is likely because the decreased river flow can cause issues such habitat degradation, higher in-river temperatures, and decreased water quality. However, because flows and environmental conditions are very consistent in these water year types, the traps can maintain consistent sampling and generally can avoid gaps in sampling of greater than seven days where passage estimates cannot be calculated (Appendix 7).

Biological Observations

Biological data were collected throughout the season to correlate environmental parameters with temporal presence and abundance of salmonids. The data were collected for a subsample of all salmonids to evaluate potential changes in health, growth, and life history strategies. As seen in previous years of biological sampling on the lower American River, most of the fall-run population emigrated as age-0 fry from the American River (PSMFC 2013 – 2023, Snider and Titus 2001). In the Central Valley, this emigration timing is highly representative of an ocean-type life history where recently emerged fry emigrate from their natal stream prior to the summer season before entering the ocean (Kjelson and Raquel 1981). The ocean-type life history strategy remained the primary life history strategy used in 2024 with 98% (n = 81,362) of the season's fall-run catch being captured before April 15. During this period, fork lengths averaged 38 mm with 93% of the subsampled fish identified as yolk-sac fry or button-up fry. After April 15, a steady increase in temperature, average fish length, and the ratio of parr, silvery parr, and smolt life stages were observed (Figure 13, Figure 16).

During the 2024 sampling season, the lower American River experienced in-river temperatures slightly below the historic average, resulting in Chinook Salmon fork lengths that were also slightly below average (Appendix 11, Appendix 12). The optimal growth temperature range of 15–19 °C was not observed at the Watt Avenue USGS station until May 27 (Myrick and Cech 2001). In an average year, the daily average temperature of 15 °C at this station is typically reached in early May (Appendix 12). Due to the lower river temperatures and the consequent shorter fork lengths, a higher number of LAD late fall Chinook Salmon were captured during the 2024 sampling season (PSMFC 2013–2023). These fish were likely smaller fall-run Chinook Salmon, as there is usually a significant size difference between fall-run and late fall-run Chinook Salmon in years with normal in-river temperatures.

Since PSMFC began operating the American River RSTs in 2013, the yearly average condition factor (K) has remained relatively stable (Figure 18). Minor improvements in the condition factor on the lower American River may be attributed to factors such as suitable water temperatures for salmonid rearing, variable flow rates, and habitat quality improvements. However, further research is needed to determine the significance of each variable. The button-up fry life stage continued to have the lowest average K value compared to other juvenile life stages in 2024. This is likely because Chinook salmon typically have a low body depth relative to their fork length during the fry life stage. As juveniles develop into later life stages and rely entirely on external feeding, their condition factors generally increase, reflecting a more robust body shape.

In 2024, none of the 37 LAD spring-run Chinook Salmon that underwent genetic run assignment were genetically confirmed to be spring-run. Although the LAD criteria developed by Fischer continued to inaccurately assign this run, which is consistent throughout the Central

Valley (Harvey et al. 2014), there appears to be a higher likelihood that LAD spring-run captured early in the season will ultimately be genetically confirmed spring-run. From 2015 through 2024, 233 LAD natural origin spring-run were genetically sampled before March 1, with 30 (12.9%) confirmed as genetic spring-run. However, after March 1, the accuracy of the LAD criteria for spring-run decreases significantly, as only 10 (1.3%) of the 757 LAD natural origin spring-run sampled were genetically confirmed as spring-run (Appendix 14). This discrepancy is likely due to warmer water temperatures later in the sampling season, which increase the number of LAD spring-run captured. Additionally, early in the sampling season, the size of fall-run does not vary much, with an average fork length well below the LAD spring-run cut-off.

It is also worth noting that the Abernathy Fish Technology Center, who has conducted genetic run assignment testing in previous sampling seasons, is currently using genetic markers that may incorrectly assign Feather River spring-run Chinook Salmon as fall-run with high confidence. Ultimately, LAD spring-run genetic samples collected in previous sampling seasons and their associated genetic run assignments may have previously underestimated the total raw catch of spring-run Chinook Salmon captured. However, funding for new genetic markers developed by NOAA that will detect the Feather River spring-run is expected after this year, and will likely be implemented in future sampling seasons.

In 2024, nine (75%) of the 12 LAD winter run were classified as genetically confirmed winter-run. The remaining three (25%) were classified as “no call” and unable to determine genetic run assignment through SNP genetic analysis. These samples were labeled as “no call” because either the tissue was not found at extraction or did not make it into the solution to get the DNA (per communications with Abernathy Fish Technology Center). However, because SNP genetic testing continued to accurately assign winter-run in 2024, the three “no call” were classified as winter-run for their final run assignments.

Two adipose-clipped Chinook Salmon were captured on January 26 and April 28, respectively. Since no adipose-clipped Chinook Salmon releases occurred on the lower American River before January 26, a genetic sample was collected from the first salmon and analyzed using SNP genetic markers (Appendix 8). The genetic analysis indicated that this individual was a winter-run. Additionally, the coded wire tag revealed it was part of the Livingston Stone Hatchery Winter-Run release on December 22, 2023. Adipose-clipped Chinook Salmon from other rivers (e.g., Feather, Sacramento) are not uncommon to capture at the lower American River RSTs, especially in high water years (PSMFC 2017 and PSMFC 2023). This is likely due to differences in discharges between the Sacramento and American Rivers, occasionally causing backflow into the American River and providing rearing opportunities for larger non-natal fish (Maslin et al. 1998, Phillis et al. 2017, Figure 12, Appendix 2). No genetic sample was collected for the second adipose-clipped Chinook Salmon that was captured on April 28. However, because it was captured shortly after the NFH release of 841,000 fall-run Chinook Salmon, which followed the constant fractional marking rate of 25%, and its fork length

(85 mm) was similar to the average release fork length (90 mm), it was ultimately presumed to be part of this release and was assigned as a fall-run.

California Central Valley natural origin steelhead were assessed for life stage, fork length, and weighed if greater than 40 mm. Between 2013 and 2023, 4,716 steelhead were captured (annual mean: 429), with 2,206 of these fish captured in 2013. During the 2024 season, 167 steelhead were captured, all of which were age-0 juveniles. In previous years, the number of redds observed near the trap and the total number of steelhead redds on the lower American River influenced the quantity of juveniles captured (CFS 2022, PSMFC 2013–2023). The highest number of redds observed between 2013 and 2023 was in 2013, with 316 redds identified, coinciding with the highest catch of juvenile steelhead in the RSTs. The life stage composition observed in 2024 aligns with previous observations on the American River, with most steelhead captured being recently emerged, age-0 juveniles.

Conclusion

The 2024 RST sampling effort to quantify catch and passage of emigrating juvenile salmonids met all study objectives. At the request of USFWS, passage estimates were calculated using the previous CAMP RST Platform Mark-Spline Model until the new efficiency model is completed. The data collected during the 2024 sampling season provides valuable insight into salmonid emigration behavior in colder, higher-water years. However, we acknowledge several limitations and challenges when interpreting the data collected in 2024 and comparing to previous years due to limitations in sampling, differences in sampling methodologies, and in-river hatchery releases.

Juvenile salmonid emigration monitoring will continue on the lower American River in 2025. To achieve the highest accuracy in catch and passage estimation while ensuring maximum safety, several adjustments are recommended for future seasons. First, given the limited trap efficiency trials during high water years, more trials should be conducted at various flow levels to better understand trap efficiency across different water year types. Second, minimizing significant gaps in sampling will enhance the accuracy of raw catch and passage estimates. These efforts aim to strengthen the lower American River RST project by improving our understanding of juvenile salmonids while maintaining safe sampling practices for our staff and the public.

Acknowledgements

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Appendix 1: **A view of the lower American River below the Watt Ave Bridge under various flow conditions.**

500 cfs 3/20/2014

1,500 cfs 4/24/2014

7,000 cfs 2/23/2016

15,000 cfs 5/31/2023

30,000 cfs 3/13/2023

60,000 cfs 1/11/2017

Appendix 2: **A view of the lower American River below the Watt Ave Bridge under various flow conditions during the 2024 lower American River RST sampling season.**

1,900 cfs 1/5/2024

1,750 cfs 2/6/2024

6,000 cfs 2/23/2024

Appendix 3: **Weekly environmental conditions during the 2024 lower American River RST sampling season.**

Julian Week	Water Temperature (C°) Avg (range)	Discharge (cfs) Avg (range)	DO (mg/L) Avg (range)	Turbidity (NTU) Avg (range)	Velocity (m/s) Avg (range)
1/1 - 1/7	10.7 (9.6 - 11.8)	2,020 (1,740 - 2,350)	10.66 (10.23 - 11.33)	1.95 (1.84 - 2.19)	1.3 (1.2 - 1.3)
1/8 - 1/14	9.9 (9.0 - 10.9)	1,774 (1,700 - 1,860)	10.37 (10.16 - 10.53)	1.39 (0.72 - 2.00)	1.2 (1.1 - 1.4)
1/15 - 1/21	10.6 (9.7 - 11.5)	1,792 (1,710 - 1,880)	10.15 (9.80 - 10.44)	0.56 (0.31 - 0.95)	1.2 (0.9 - 1.4)
1/22 - 1/28	10.9 (10.2 - 11.8)	1,788 (1,710 - 1,850)	10.30 (10.11 - 10.51)	0.89 (0.28 - 1.53)	1.1 (1.0 - 1.2)
1/29 - 2/4	10.8 (9.5 - 12.0)	1,745 (1,670 - 1,830)	10.26 (10.15 - 10.33)	0.79 (0.35 - 1.69)	1.1 (1.0 - 1.1)
2/5 - 2/11	10.3 (9.0 - 11.3)	2,311 (1,680 - 3,720)	-	-	-
2/12 - 2/18	10.0 (9.2 - 11.1)	5,312 (3,550 - 6,470)	-	-	-
2/19 - 2/25	10.4 (9.8 - 11.8)	6,172 (3,930 - 6,500)	-	-	-
2/26 - 3/4	10.2 (9.4 - 11.9)	6,255 (5,950 - 6,470)	10.90 (10.56 - 11.50)	3.34 (2.02 - 4.28)	0.8 (0.6 - 1.0)
3/5 - 3/11	10.6 (9.7 - 12.0)	6,216 (5,990 - 6,520)	10.85 (10.59 - 11.31)	2.46 (1.86 - 2.99)	0.8 (0.6 - 1.1)
3/12 - 3/18	11.2 (9.8 - 13.2)	5,369 (4,920 - 6,240)	10.64 (10.22 - 11.23)	1.96 (1.64 - 2.69)	1.0 (0.8 - 1.2)
3/19 - 3/25	11.5 (10.5 - 13.3)	4,917 (4,480 - 5,460)	10.47 (10.25 - 10.94)	1.66 (1.26 - 2.00)	1.2 (1.0 - 1.5)
3/26 - 4/1	11.4 (10.3 - 13.8)	4,321 (3,930 - 4,900)	10.21 (10.10 - 10.40)	1.44 (1.06 - 1.92)	1.2 (1.0 - 1.4)
4/2 - 4/8	11.7 (9.9 - 14.3)	4,101 (3,950 - 4,380)	10.17 (9.95 - 10.56)	1.93 (1.23 - 3.37)	1.2 (1.0 - 1.4)
4/9 - 4/15	12.3 (10.4 - 14.7)	4,174 (3,970 - 4,540)	9.96 (9.79 - 10.25)	1.48 (1.00 - 1.86)	1.1 (0.9 - 1.3)
4/16 - 4/22	13.1 (11.4 - 15.6)	4,325 (4,030 - 5,350)	10.36 (9.90 - 11.70)	1.59 (1.05 - 2.28)	1.3 (1.1 - 1.4)
4/23 - 4/29	12.8 (11.4 - 15.7)	4,607 (4,010 - 5,280)	9.65 (9.50 - 9.81)	1.82 (1.05 - 3.18)	1.1 (0.8 - 1.4)
4/30 - 5/6	13.1 (11.0 - 15.8)	4,142 (3,990 - 4,460)	9.50 (9.29 - 9.74)	1.38 (1.02 - 1.77)	1.2 (0.7 - 1.5)
5/7 - 5/13	14.1 (11.8 - 16.4)	4,114 (3,950 - 4,520)	9.72 (9.31 - 10.70)	1.49 (0.88 - 3.03)	1.1 (0.8 - 1.3)
5/14 - 5/20	14.2 (12.4 - 16.3)	4,615 (3,780 - 5,370)	9.41 (8.95 - 10.94)	1.33 (0.91 - 1.82)	1.1 (0.8 - 1.4)
5/21 - 5/27	14.5 (12.5 - 17.0)	3,596 (2,970 - 4,620)	9.39 (8.97 - 10.47)	1.20 (0.82 - 1.71)	1.1 (1.0 - 1.2)
5/28 - 6/3	15.7 (13.0 - 18.0)	2,733 (2,450 - 3,450)	9.21 (8.72 - 10.28)	1.16 (0.77 - 1.97)	1.0 (0.9 - 1.4)
6/4 - 6/10	16.7 (13.9 - 19.0)	2,549 (2,360 - 3,210)	8.88 (8.42 - 9.81)	1.57 (1.20 - 2.36)	1.0 (0.7 - 1.2)
6/11 - 6/17	16.3 (14.0 - 18.8)	3,407 (2,450 - 3,990)	8.68 (8.27 - 9.97)	1.30 (1.04 - 1.83)	1.0 (0.8 - 1.2)
6/18 - 6/24	16.3 (13.9 - 18.8)	3,558 (3,450 - 4,150)	9.32 (8.39 - 10.54)	1.52 (1.26 - 1.97)	1.0 (0.7 - 1.1)
6/25 - 7/1	16.9 (14.9 - 19.0)	4,180 (3,380 - 5,020)	9.22 (9.22)	1.85 (1.43 - 2.24)	1.0 (0.9 - 1.2)

Appendix 4: **List of natural origin fish species captured during the 2024 lower American River RST sampling season.**

Common Name	Family Name	Species Name	Total
Chinook Salmon	Salmonidae	*Oncorhynchus tshawytscha*	83,209
Rainbow Trout / steelhead	Salmonidae	*Oncorhynchus mykiss*	167
American Shad	Clupeidae	*Alosa sapidissima*	7
Bluegill	Centrarchidae	*Lepomis macrochirus*	11
Channel Catfish	Ictaluridae	*Ictalurus punctatus*	2
Common Carp	Cyprinidae	*Cyprinus carpio*	4
Golden Shiner	Cyprinidae	*Notemigonus crysoleucas*	5
Goldfish	Cyprinidae	*Carassius auratus*	1
Hardhead	Cyprinidae	*Mylopharodon conocephalus*	190
Largemouth Bass	Centrarchidae	*Micropterus salmoides*	7
Pacific Lamprey	Petromyzontidae	*Lampetra tridentata*	911
Prickly Sculpin	Cottidae	*Cottus asper*	24
Redear Sunfish	Centrarchidae	*Lepomis microlophus*	1
Riffle Sculpin	Cottidae	*Cottus gulosus*	100
River Lamprey	Petromyzontidae	*Lampetra ayresii*	13
Sacramento Pikeminnow	Cyprinidae	*Ptychocheilus grandis*	81
Sacramento Sucker	Catostomidae	*Catostomus occidentalis*	89
Spotted Bass	Centrarchidae	*Micropterus punctulatus*	7
Striped Bass	Moronidae	*Morone saxatilis*	1
Threadfin Shad	Clupeidae	*Dorosoma petenense*	39
Threespine Stickleback	Gasterosteidae	*Gasterosteus aculeatus*	85
Tule Perch	Embiotocidae	*Hysterocarpus traskii*	2
Unknown bass	Centrarchidae	*Micropterus sp.*	124
Unknown lamprey	Petromyzontidae	*Entosphenus or Lampetra*	226
Unknown minnow	Cyprinidae		8
Unknown sculpin	Cottidae	*Cottus spp.*	7
Unknown sunfish	Centrarchidae	*Lepomis spp.*	4
Wakasagi	Osmeridae	*Hypomesus nipponensis*	23
Western Mosquitofish	Poeciliidae	*Gambusia affinis*	1

Appendix 5: **Average Fulton's condition factor (Avg) and minimum and maximum condition factor (Range) by life stage for natural origin fall-run Chinook Salmon captured in the lower American River RSTs from 2013 through 2024.**

Year	Water Year Type	Button-up fry Avg (Range)	Parr Avg (Range)	Silvery Parr Avg (Range)	Smolt Avg (Range)
2013	Dry	0.88 (0.31 - 2.47)	0.99 (0.46 - 2.62)	1.05 (0.65 - 2.79)	1.13 (1.13)
2014	Critical	0.83 (0.47 - 1.41)	1.01 (0.51 - 2.18)	1.06 (0.41 - 1.53)	1.08 (0.45 - 1.55)
2015	Critical	0.87 (0.47 - 2.03)	0.99 (0.51 - 3.40)	1.02 (0.66 - 1.62)	1.07 (0.88 - 2.04)
2016	Below Normal	0.87 (0.36 - 1.31)	0.98 (0.56 - 1.54)	1.06 (0.89 - 1.23)	1.04 (1.04)
2017	Wet	0.85 (0.58 - 1.88)	1.00 (0.56 - 1.61)	1.05 (0.42 - 1.76)	1.08 (0.85 - 1.65)
2018	Below Normal	0.91 (0.47 - 2.76)	0.99 (0.40 - 2.41)	1.04 (0.73 - 1.85)	1.10 (0.93 - 1.33)
2019	Wet	0.92 (0.58 - 1.62)	1.00 (0.21 - 1.59)	1.06 (0.86 - 1.65)	0.99 (0.99)
2020	Dry	0.90 (0.23 - 1.65)	0.95 (0.23 - 3.54)	1.03 (0.32 – 2.00)	0.95 (0.41 - 1.44)
2021	Critical	0.97 (0.47 - 2.03)	1.04 (0.44 - 2.36)	1.06 (0.67 - 1.68)	1.06 (0.89 - 1.47)
2022	Critical	0.84 (0.44 - 1.41)	1.01 (0.64 - 1.46)	1.05 (0.73 - 1.52)	1.08 (0.93 - 1.34)
2023	Wet	0.84 (0.44 - 1.31)	1.03 (0.64 - 1.85)	1.11 (0.77 - 1.52)	1.13 (1.11 - 1.16)
2024	Above Normal	0.91 (0.47 - 1.43)	1.00 (0.53 - 1.64)	1.08 (0.75 - 1.54)	1.10 (1.00 - 1.19)

Appendix 6: **Median discharge (cfs) between January 1 and June 30, total catch of fall-run Chinook Salmon, spring-run Chinook Salmon, winter-run Chinook Salmon, steelhead, and lamprey, and the associated fall-run Chinook Salmon passage estimates with 95% confidence intervals calculated the CAMP RST Mark-Spline Model for the lower American River RSTs from 2013 through 2024.**

Year	Water Year Type	Discharge (cfs)	Fall-run	Spring-run	Winter-run	steelhead	lamprey	Fall-Run Passage Estimates
2013	Dry	1,897	262,589	14	39	2,206	1,917	5,709,000 (5,160,000 – 6,340,000
2014	Critical	560	379,542	5	13	592	1,525	1,726,000 (1,552,000 – 1,965,000)
2015	Critical	881	283,153	19	28	11	953	1,459,000 (1,335,000 – 1,577,000)
2016	Below Normal	3,776	80,626	2	1	332	1,217	2,344,000 (2,064,000 – 2,609,000)
2017	Wet	9,459	9,567	1	0	28	269	754,800 (535,200 – 980,500)
2018	Below Normal	2,857	90,104	0	11	162	1,093	1,287,000 (1,183,000 – 1,416,000)
2019	Wet	7,726	15,056	9	18	337	176	3,754,000 (2,262,000 – 6,327,000)
2020	Dry	1,828	152,378	16	203	101	1,361	1,404,000 (1,331,000 – 1,500,000)
2021	Critical	1,172	35,433	4	3	283	2,153	344,700 (327,000 – 370,300)
2022	Critical	1,922	31,581	1	1	404	2,820	262,200 (244,300 – 281,700)
2023	Wet	7,620	70,348	4	13	260	1,693	3,032,000 (2,610,000 – 3,518,000)
2024	Above Normal	4,085	83,196	0	13	167	1,150	2,775,000 (2,479,000 – 3,086,000)

Passage estimates in this table were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.

Appendix 7: **Daily fall-run Chinook Salmon passage estimates calculated through the CAMP RST Mark-Spline Model and days no production estimates could be calculated (No PE) for the lower American River RSTs from 2013 through 2024.**

Date	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1/1	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
1/2	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
1/3	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
1/4	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
1/5	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
1/6	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	1,205
1/7	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	2,252
1/8	No PE	108	No PE	No PE	No PE	No PE	No PE	59	No PE	No PE	No PE	2,183
1/9	No PE	249	86	No PE	No PE	No PE	No PE	68	No PE	No PE	No PE	1,780
1/10	No PE	287	37	No PE	No PE	No PE	87	772	No PE	No PE	No PE	1,318
1/11	No PE	118	73	No PE	No PE	No PE	87	0	No PE	No PE	No PE	2,685
1/12	No PE	98	244	0	No PE	8,218	1,172	0	0	No PE	No PE	4,832
1/13	No PE	432	542	0	No PE	5,286	1,363	203	0	No PE	No PE	3,172
1/14	No PE	634	731	66	No PE	5,802	2,662	61	7	No PE	No PE	4,658
1/15	No PE	777	1,228	0	No PE	5,922	1,215	756	0	136	No PE	6,388
1/16	No PE	1,287	872	0	No PE	5,583	434	525	0	58	No PE	18,068
1/17	No PE	2,005	678	133	No PE	7,069	13,816	1,610	14	39	No PE	12,485
1/18	No PE	2,734	874	57	No PE	10,074	19,578	723	18	223	No PE	57,784
1/19	No PE	2,348	1,189	33	No PE	8,218	4,543	621	21	340	No PE	22,981
1/20	No PE	1,536	1,477	33	No PE	35,119	21,438	469	10	641	No PE	10,108
1/21	No PE	1,921	3,075	464	No PE	29,927	24,833	686	85	797	No PE	59,008
1/22	No PE	1,770	4,677	1,732	No PE	7,246	28,746	296	67	204	No PE	41,460
1/23	No PE	1,954	5,558	497	No PE	7,383	33,324	3,171	49	525	No PE	36,031

1/24	2,782	1,469	4,483	897	No PE	16,206	40,524	950	134	486	No PE	57,510
1/25	9,607	1,137	5,483	763	No PE	8,754	88,323	1,502	98	272	1,003	111,732
1/26	13,509	2,249	10,948	962	No PE	20,859	95,818	944	388	651	1,717	120,039
1/27	69,761	2,962	3,410	465	No PE	17,116	70,323	2,052	360	457	4,385	62,191
1/28	77,463	1,438	8,781	765	No PE	55,894	52,641	2,192	513	554	6,403	83,135
1/29	57,691	1,136	10,863	299	No PE	18,900	76,400	4,959	339	855	5,130	291,489
1/30	111,931	771	17,230	199	No PE	46,955	74,779	2,338	885	933	9,290	87,334
1/31	60,753	1,666	27,174	199	No PE	55,367	117,957	4,527	1,689	874	9,747	50,056
2/1	73,571	8,419	23,166	1,195	No PE	39,003	97,034	6,289	2,002	2,176	10,776	No PE
2/2	36,262	10,125	24,042	861	5,205	82,680	144,402	4,508	1,149	2,588	12,635	No PE
2/3	53,891	12,066	34,383	1,927	8,399	53,884	167,212	9,766	1,442	3,031	13,072	No PE
2/4	80,665	14,241	25,511	930	19,727	33,983	229,513	15,880	1,515	3,494	17,380	No PE
2/5	78,006	16,394	13,376	1,726	No PE	30,608	261,612	13,533	2,005	3,970	16,107	No PE
2/6	93,382	13,128	2,774	9,332	No PE	26,978	169,498	16,047	2,283	4,321	30,463	No PE
2/7	68,244	13,245	17,153	5,763	No PE	20,717	No PE	21,096	2,941	3,778	25,820	No PE
2/8	84,348	1,570	23,867	15,661	No PE	22,980	No PE	34,675	1,946	4,834	34,318	No PE
2/9	67,991	26,210	110,021	23,976	No PE	22,769	No PE	48,655	855	4,508	40,211	No PE
2/10	81,893	59,570	127,409	16,463	No PE	22,126	No PE	60,073	1,006	4,880	39,690	No PE
2/11	96,431	45,029	78,807	26,587	No PE	17,570	No PE	67,991	2,859	5,216	30,683	No PE
2/12	70,565	60,133	45,445	22,263	No PE	21,523	No PE	38,465	3,198	5,388	33,854	No PE
2/13	82,372	16,717	41,511	29,679	No PE	21,173	No PE	23,893	3,561	5,894	45,265	No PE
2/14	85,259	13,740	29,698	26,939	No PE	20,796	No PE	23,711	3,773	4,257	35,376	No PE
2/15	92,488	5,969	24,843	31,510	No PE	15,733	No PE	17,766	49	5,463	47,035	No PE
2/16	102,200	18,088	26,015	37,891	No PE	17,626	No PE	12,477	227	16,107	43,806	No PE
2/17	124,564	143,724	18,911	23,428	No PE	16,739	No PE	14,450	219	10,256	39,485	No PE
2/18	139,434	147,996	19,690	46,450	No PE	16,749	No PE	12,172	3,745	9,179	55,409	No PE
2/19	63,863	66,081	20,383	70,541	No PE	18,133	No PE	19,177	1,718	13,130	54,705	No PE
2/20	220,362	30,039	5,436	46,232	No PE	19,209	No PE	21,959	2,356	11,670	61,661	No PE

2/21	328,394	52,059	10,302	92,549	No PE	4,503	No PE	22,402	2,883	8,343	58,903	No PE
2/22	226,931	28,993	39,211	92,563	No PE	14,168	105,195	22,973	8,762	4,956	79,431	No PE
2/23	81,171	16,381	21,604	78,061	No PE	13,434	108,957	23,662	7,338	7,068	84,596	No PE
2/24	428,647	14,611	28,272	42,138	No PE	12,749	98,654	24,459	10,632	7,184	89,835	No PE
2/25	402,972	13,055	35,142	68,736	No PE	13,760	97,989	25,634	18,341	5,692	79,089	No PE
2/26	325,017	10,038	35,438	59,583	No PE	2,614	No PE	4,095	27,131	4,808	49,014	No PE
2/27	249,193	29,259	39,910	62,411	No PE	16,353	No PE	6,879	25,187	2,533	113,470	No PE
2/28	60,292	18,115	21,387	71,195	No PE	30,037	No PE	7,487	26,398	4,156	149,786	No PE
2/29	-	-	-	80,880	-	-	-	2,578	-	-	-	119,418
3/1	201,470	42,722	47,208	42,316	No PE	9,965	No PE	1,251	14,851	2,338	187,953	110,805
3/2	49,556	164,923	58,840	75,543	No PE	9,524	No PE	32,475	4,524	3,199	123,346	144,189
3/3	13,679	59,992	50,493	51,205	No PE	9,116	No PE	24,731	2,178	1,809	143,807	117,236
3/4	92,995	19,487	68,596	50,600	6,038	10,103	No PE	35,342	4,201	1,772	54,638	85,296
3/5	130,923	11,892	44,623	85,964	3,111	25,854	No PE	51,774	2,806	1,852	90,771	65,467
3/6	15,912	34,377	26,277	65,171	7,112	10,358	No PE	48,580	1,930	3,137	333,676	98,007
3/7	27,567	54,265	18,440	77,091	10,459	2,602	No PE	2,525	1,807	2,975	115,730	91,058
3/8	43,926	33,324	5,050	No PE	13,837	2,322	No PE	57,713	2,634	2,392	94,783	68,118
3/9	62,986	7,439	2,972	No PE	20,278	3,177	No PE	6,644	5,337	2,229	106,399	60,982
3/10	30,735	12,411	1,561	No PE	16,220	3,210	No PE	199,353	825	2,290	No PE	55,702
3/11	31,087	26,672	344	No PE	19,512	3,984	No PE	59,854	7,177	2,608	No PE	28,658
3/12	43,715	19,308	1,002	No PE	13,884	4,261	No PE	40,094	6,843	2,369	No PE	19,015
3/13	28,938	19,828	475	No PE	18,861	1,776	28,853	19,883	6,877	572	No PE	50,896
3/14	24,270	10,428	495	No PE	20,537	3,900	37,303	1,566	4,355	954	No PE	26,841
3/15	23,481	12,260	598	No PE	26,520	3,049	52,757	3,007	2,148	574	No PE	20,854
3/16	20,175	17,547	298	No PE	24,434	5,900	41,036	2,588	4,726	1,448	No PE	24,184
3/17	15,890	13,840	262	No PE	40,775	15,847	46,332	5,218	4,049	1,313	No PE	26,902
3/18	10,131	16,506	382	No PE	39,239	11,818	75,792	7,259	2,262	2,630	No PE	25,934
3/19	4,172	12,150	540	No PE	20,219	5,432	72,869	15,276	1,385	762	No PE	34,572

3/20	3,437	5,342	487	No PE	16,887	3,940	25,611	10,778	3,039	1,035	No PE	35,663
3/21	18,273	9,806	2,122	No PE	7,299	No PE	131,848	7,323	3,705	1,393	No PE	23,728
3/22	20,355	11,075	2,525	40,729	15,500	No PE	205,180	4,696	3,676	1,154	No PE	25,181
3/23	26,005	10,057	380	65,981	11,103	No PE	72,030	3,989	2,468	706	No PE	6,377
3/24	27,243	6,712	524	51,691	6,340	No PE	179,453	2,352	4,622	763	7,337	12,979
3/25	14,678	4,185	465	41,494	3,435	No PE	73,188	5,156	2,261	534	7,584	67,113
3/26	8,888	7,217	472	58,369	6,582	No PE	50,939	4,982	9,334	745	11,124	13,529
3/27	8,015	10,637	1,193	62,750	5,620	No PE	41,702	4,401	15,673	522	14,255	19,357
3/28	2,438	3,313	1,098	61,349	10,836	No PE	47,495	3,708	11,445	282	10,559	8,369
3/29	8,663	6,479	1,372	77,810	9,855	No PE	31,347	2,689	4,005	246	31,399	5,766
3/30	6,011	6,917	1,930	71,996	8,930	3,256	9,000	2,565	2,307	505	16,164	8,895
3/31	5,372	4,152	1,689	74,254	8,088	9,217	5,383	3,719	1,005	971	24,010	6,802
4/1	4,451	7,141	4,294	53,436	7,307	10,045	3,588	No PE	1,176	496	14,648	6,541
4/2	3,372	8,462	5,280	64,516	8,927	10,624	5,643	No PE	1,058	730	17,553	5,888
4/3	3,323	3,832	5,771	47,478	5,356	8,720	10,187	No PE	298	885	18,356	3,715
4/4	2,023	2,582	1,091	28,874	5,134	4,990	8,792	No PE	291	974	20,992	3,368
4/5	3,381	4,900	1,624	No PE	7,475	2,394	11,032	No PE	196	1,030	16,796	2,188
4/6	2,339	6,640	4,199	No PE	4,062	No PE	8,653	No PE	319	1,521	18,977	4,028
4/7	5,204	2,475	962	No PE	10,825	No PE	2,923	No PE	292	1,221	8,523	3,101
4/8	5,371	1,847	3,076	No PE	3,741	No PE	1,476	No PE	138	1,182	11,868	2,139
4/9	5,566	2,438	1,926	No PE	4,174	No PE	2,605	2,949	273	949	13,417	1,744
4/10	6,866	8,807	767	No PE	6,948	No PE	1,244	5,898	224	935	13,084	1,869
4/11	1,549	4,596	1,808	No PE	3,666	No PE	1,302	6,812	252	847	8,067	1,384
4/12	2,395	3,665	2,476	No PE	3,757	No PE	2,113	1,735	225	2,677	7,857	1,535
4/13	1,224	4,925	811	No PE	3,397	No PE	1,302	1,365	284	1,894	6,211	3,130
4/14	828	9,405	1,033	No PE	9,528	3,267	1,563	1,335	319	791	3,525	2,051
4/15	4,030	3,675	1,074	No PE	2,507	2,601	2,749	1,957	281	980	2,582	1,797
4/16	3,356	3,335	754	No PE	2,435	1,935	2,026	2,179	246	517	2,615	1,631

4/17	8,632	4,506	1,072	No PE	2,898	5,836	4,630	1,194	239	2,207	2,106	2,657
4/18	10,843	2,959	1,857	No PE	1,086	2,434	2,113	1,404	305	1,967	2,225	2,099
4/19	16,492	2,452	2,313	No PE	3,463	2,242	3,270	1,570	275	568	1,512	1,581
4/20	21,168	3,188	767	No PE	2,332	1,731	1,621	971	779	581	1,200	2,004
4/21	18,806	1,592	681	No PE	2,342	2,199	2,865	681	347	385	846	1,897
4/22	13,504	1,448	750	No PE	2,357	1,556	6,048	2,133	555	544	640	1,798
4/23	40,932	623	640	No PE	2,404	1,673	5,122	1,454	644	291	726	1,429
4/24	37,017	300	1,025	No PE	2,704	1,034	8,219	1,447	456	1,272	479	1,070
4/25	24,886	352	1,056	No PE	1,999	1,603	11,315	1,462	816	1,813	367	1,739
4/26	26,538	1,572	1,408	No PE	363	2,299	15,164	361	4,671	1,348	513	770
4/27	14,252	1,926	1,499	No PE	772	1,751	15,344	958	5,239	915	789	914
4/28	12,454	1,520	1,346	No PE	926	1,382	25,976	1,319	2,744	757	1,055	1,141
4/29	5,416	1,150	1,107	No PE	261	2,376	53,862	1,402	942	985	378	1,328
4/30	6,655	860	1,939	No PE	2,973	1,143	53,480	993	399	1,262	367	1,253
5/1	5,609	824	823	No PE	3,893	818	No PE	1,087	275	1,072	239	1,290
5/2	4,401	848	1,094	No PE	313	1,229	No PE	1,856	538	749	374	1,096
5/3	8,929	921	1,458	No PE	1,333	795	No PE	1,338	222	382	239	934
5/4	2,682	1,202	833	No PE	2,372	1,191	No PE	4,537	159	398	348	1,189
5/5	1,962	373	550	No PE	1,179	1,043	No PE	3,532	365	300	427	2,257
5/6	2,557	374	347	No PE	2,597	737	No PE	2,004	130	347	479	1,305
5/7	3,008	916	421	No PE	4,121	536	No PE	1,557	260	374	846	1,635
5/8	2,696	291	427	No PE	4,326	1,210	No PE	1,554	580	443	666	1,767
5/9	1,883	186	631	No PE	4,833	1,199	No PE	1,545	524	253	539	690
5/10	1,991	543	738	No PE	5,172	1,340	No PE	1,531	492	231	950	2,007
5/11	3,020	667	238	No PE	8,915	1,355	No PE	1,435	127	136	531	1,074
5/12	1,885	602	145	No PE	8,588	1,373	No PE	701	218	167	614	1,176
5/13	1,711	401	189	No PE	9,429	1,397	No PE	862	99	135	483	1,379
5/14	1,814	769	67	No PE	5,706	1,386	No PE	959	98	241	1,139	1,595

5/15	1,898	1,051	64	No PE	7,270	2,244	No PE	1,347	228	298	647	1,328
5/16	1,872	408	143	No PE	4,537	2,903	No PE	1,289	219	86	655	1,667
5/17	1,498	343	161	No PE	6,409	2,257	No PE	1,225	117	50	No PE	1,700
5/18	1,864	349	102	No PE	6,538	1,586	No PE	1,109	189	29	No PE	979
5/19	1,767	76	12	No PE	6,313	1,642	No PE	374	134	0	No PE	1,293
5/20	2,070	39	61	No PE	5,488	1,754	No PE	621	102	52	No PE	890
5/21	2,492	39	49	No PE	7,111	774	No PE	1,344	91	174	No PE	773
5/22	2,371	41	30	No PE	7,596	1,468	No PE	1,161	69	231	No PE	1,257
5/23	3,049	60	41	No PE	6,335	No PE	No PE	1,064	60	52	No PE	1,545
5/24	2,969	No PE	33	No PE	8,830	No PE	No PE	917	57	36	No PE	3,689
5/25	609	No PE	32	No PE	7,340	No PE	No PE	779	63	0	No PE	800
5/26	652	No PE	37	No PE	7,292	No PE	No PE	613	113	5	No PE	769
5/27	952	No PE	37	No PE	7,199	No PE	No PE	65	70	15	No PE	1,008
5/28	1,393	No PE	31	No PE	7,069	No PE	No PE	378	46	138	No PE	777
5/29	773	No PE	31	No PE	9,788	No PE	No PE	457	21	133	No PE	169
5/30	1,188	No PE	No PE	No PE	5,521	No PE	No PE	273	17	179	No PE	1,254
5/31	1,615	No PE	No PE	No PE	3,639	No PE	No PE	210	14	12	No PE	439
6/1	428	No PE	No PE	No PE	No PE	No PE	No PE	183	10	0	No PE	569
6/2	No PE	No PE	No PE	No PE	No PE	No PE	No PE	263	25	No PE	No PE	749
6/3	No PE	No PE	No PE	No PE	No PE	No PE	No PE	128	31	No PE	No PE	761
6/4	No PE	No PE	No PE	No PE	No PE	No PE	No PE	124	38	No PE	No PE	419
6/5	No PE	No PE	No PE	No PE	No PE	No PE	No PE	107	No PE	No PE	No PE	349
6/6	No PE	No PE	No PE	No PE	No PE	No PE	No PE	42	No PE	No PE	1,545	314
6/7	No PE	No PE	No PE	No PE	No PE	No PE	No PE	37	No PE	No PE	1,141	331
6/8	No PE	No PE	No PE	No PE	No PE	No PE	No PE	37	No PE	No PE	1,403	388
6/9	No PE	No PE	No PE	No PE	No PE	No PE	No PE	24	No PE	No PE	1,399	534
6/10	No PE	No PE	No PE	No PE	No PE	No PE	No PE	39	No PE	No PE	1,418	445
6/11	No PE	No PE	No PE	No PE	No PE	No PE	No PE	39	No PE	No PE	1,922	126

6/12	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	1,897	81
6/13	No PE	No PE	No PE	No PE	2,495	No PE	No PE	No PE	No PE	No PE	977	35
6/14	No PE	No PE	No PE	No PE	2,094	No PE	No PE	No PE	No PE	No PE	1,942	154
6/15	No PE	No PE	No PE	No PE	2,196	No PE	No PE	No PE	No PE	No PE	932	330
6/16	No PE	No PE	No PE	No PE	1,792	No PE	No PE	No PE	No PE	No PE	1,160	468
6/17	No PE	No PE	No PE	No PE	871	No PE	No PE	No PE	No PE	No PE	810	63
6/18	No PE	No PE	No PE	No PE	1,545	No PE	No PE	No PE	No PE	No PE	752	172
6/19	No PE	No PE	No PE	No PE	1,551	No PE	No PE	No PE	No PE	No PE	996	0
6/20	No PE	No PE	No PE	No PE	987	No PE	No PE	No PE	No PE	No PE	550	355
6/21	No PE	No PE	No PE	No PE	1,031	No PE	No PE	No PE	No PE	No PE	52	91
6/22	No PE	No PE	No PE	No PE	1,264	No PE	No PE	No PE	No PE	No PE	266	352
6/23	No PE	No PE	No PE	No PE	923	No PE	No PE	No PE	No PE	No PE	576	516
6/24	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	473	0
6/25	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	624	0
6/26	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	311	144
6/27	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	226	No PE
6/28	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	150	No PE
6/29	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
6/30	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE
7/1	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE	No PE

Passage estimates in this table were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.

Appendix 8: Genetic results for fin clip samples from Chinook Salmon captured during the 2024 lower American River RST sampling season.

Date	Sample #	Adipose Fin Status	LAD Run Assignment	SNP Run Assignment	SNP Probability	Final Run Assignment	FL (mm)	W (g)
1/7/2024	4182-001	Non-clipped	Winter	Winter	1.00	Winter	90	7.4
1/7/2024	4182-002	Non-clipped	Winter	No Call	No Call	Winter	71	3.7
1/8/2024	4182-003	Non-clipped	Winter	Winter	1.00	Winter	78	5.2
1/8/2024	4182-004	Non-clipped	Winter	Winter	1.00	Winter	84	6.3
1/8/2024	4182-005	Non-clipped	Winter	No Call	No Call	Winter	74	4.0
1/11/2024	4182-006	Non-clipped	Fall	Fall	1.00	Fall	35	-
1/12/2024	4182-008	Non-clipped	Fall	Fall	0.98	Fall	35	-
1/12/2024	4182-007	Non-clipped	Fall	Fall	1.00	Fall	36	-
1/15/2024	4182-009	Non-clipped	Fall	Fall	1.00	Fall	35	-
1/15/2024	4182-010	Non-clipped	Fall	Fall	1.00	Fall	36	-
1/16/2024	4182-011	Non-clipped	Fall	Fall	1.00	Fall	35	-
1/25/2024	4182-014	Non-clipped	Spring	Winter	1.00	Winter	50	1.6
1/25/2024	4182-015	Non-clipped	Fall	Fall	1.00	Fall	37	-
1/26/2024	4182-018	Non-clipped	Spring	Fall	0.99	Fall	54	1.5
1/26/2024	4182-016	Non-clipped	Winter	Winter	1.00	Winter	82	5.5
1/26/2024	4182-017	Non-clipped	Winter	No Call	No Call	Winter	93	9.4
1/26/2024	4182-019	Adipose Clipped	Winter	Winter	1.00	Winter	77	-
1/26/2024	4182-020	Non-clipped	Spring	Fall	1.00	Fall	49	0.9
1/27/2024	4182-021	Non-clipped	Spring	Fall	1.00	Fall	49	0.9

1/27/2024	4182-022	Non-clipped	Spring	Fall	1.00	Fall	53	1.3
1/28/2024	4182-024	Non-clipped	Winter	Winter	1.00	Winter	72	4.1
1/28/2024	4182-025	Non-clipped	Fall	Fall	1.00	Fall	36	-
1/28/2024	4182-026	Non-clipped	Fall	Fall	1.00	Fall	35	-
1/28/2024	4182-023	Non-clipped	Winter	Winter	1.00	Winter	98	11.4
1/28/2024	4182-027	Non-clipped	Fall	Fall	1.00	Fall	37	-
1/29/2024	4182-029	Non-clipped	Spring	Fall	0.99	Fall	55	-
1/29/2024	4182-028	Non-clipped	Winter	Winter	1.00	Winter	85	6.4
1/30/2024	4182-030	Non-clipped	Winter	Winter	1.00	Winter	97	10.7
1/31/2024	4182-031	Non-clipped	Winter	Winter	1.00	Winter	85	7.6
1/31/2024	4182-032	Non-clipped	Spring	Fall	1.00	Fall	53	0.9
3/13/2024	4182-033	Non-clipped	Spring	Fall	1.00	Fall	67	3.3
3/17/2024	4182-034	Non-clipped	Spring	Fall	1.00	Fall	68	3.1
3/20/2024	4182-035	Non-clipped	Spring	Fall	1.00	Fall	68	3.3
3/21/2024	4182-036	Non-clipped	Spring	Fall	1.00	Fall	74	4.6
3/24/2024	4182-037	Non-clipped	Spring	No Call	No Call	Fall	71	3.9
3/25/2024	4182-038	Non-clipped	Spring	Fall	1.00	Fall	77	4.3
3/25/2024	4182-039	Non-clipped	Spring	Fall	1.00	Fall	74	4.2
3/31/2024	4182-040	Non-clipped	Spring	Fall	1.00	Fall	77	5.0
4/2/2024	4182-041	Non-clipped	Spring	Fall	1.00	Fall	75	4.8
4/3/2024	4182-042	Non-clipped	Spring	Fall	1.00	Fall	75	4.5
4/3/2024	4182-043	Non-clipped	Spring	Fall	1.00	Fall	74	3.9
4/4/2024	4182-044	Non-clipped	Spring	Fall	1.00	Fall	84	6.0

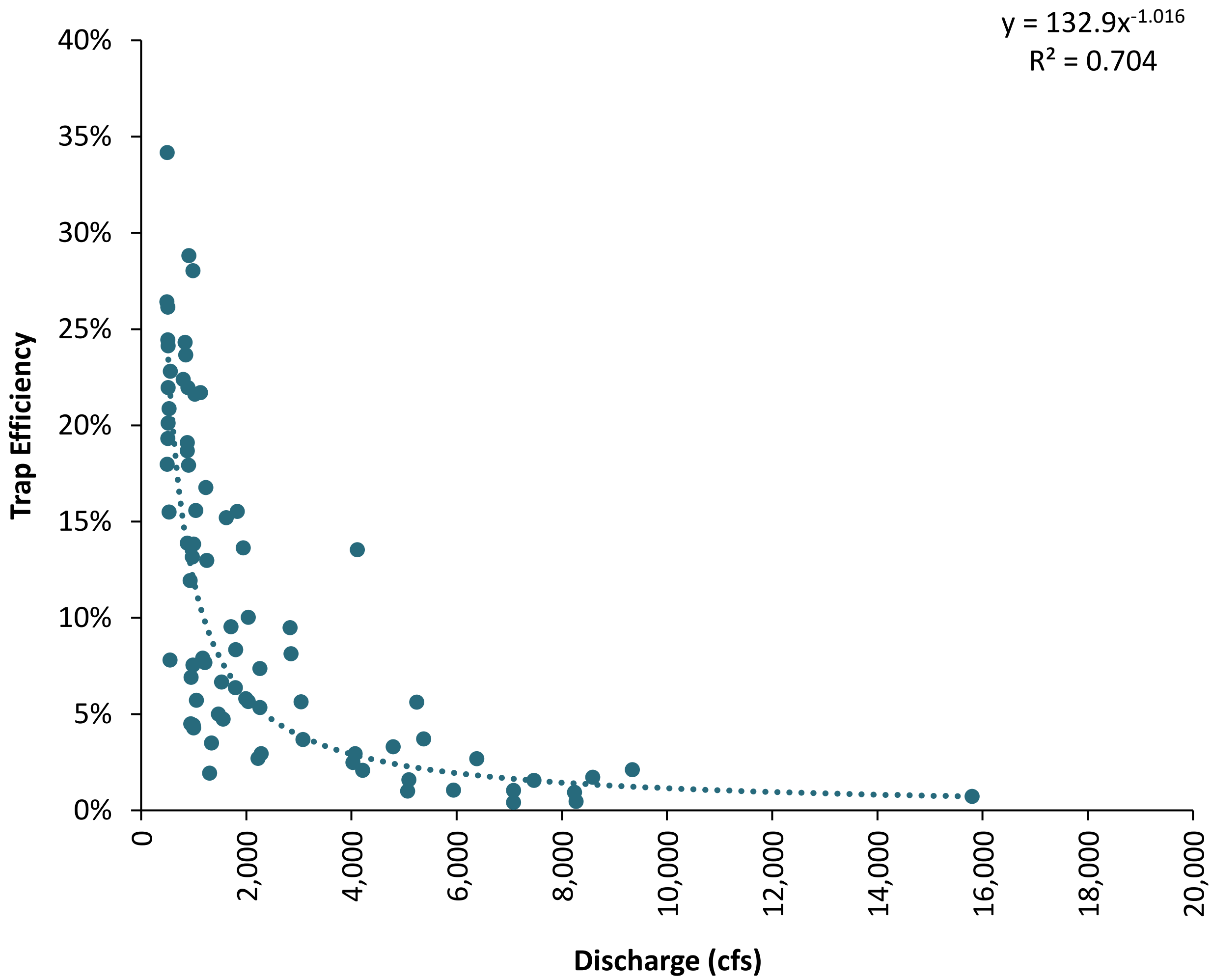
4/4/2024	4182-045	Non-clipped	Spring	Fall	1.00	Fall	76	4.3
4/6/2024	4182-046	Non-clipped	Spring	Fall	1.00	Fall	79	5.0
4/7/2024	4182-047	Non-clipped	Spring	Fall	1.00	Fall	84	7.0
4/7/2024	4182-048	Non-clipped	Spring	Fall	1.00	Fall	77	5.5
4/7/2024	4182-049	Non-clipped	Late fall	Fall	0.99	Fall	32	-
4/8/2024	4182-050	Non-clipped	Spring	Fall	1.00	Fall	87	7.0
4/9/2024	4182-051	Non-clipped	Spring	Fall	0.99	Fall	87	7.4
4/11/2024	4182-052	Non-clipped	Spring	Fall	1.00	Fall	80	5.5
4/15/2024	4182-053	Non-clipped	Spring	Fall	1.00	Fall	89	7.7
4/15/2024	4182-054	Non-clipped	Spring	Fall	1.00	Fall	86	7.2
4/16/2024	4182-055	Non-clipped	Spring	Fall	1.00	Fall	88	7.6
4/17/2024	4182-056	Non-clipped	Spring	Fall	0.98	Fall	98	8.2
4/17/2024	4182-057	Non-clipped	Spring	Fall	1.00	Fall	82	5.7
4/18/2024	4182-058	Non-clipped	Spring	Fall	1.00	Fall	83	6.7
4/18/2024	4182-059	Non-clipped	Spring	Fall	1.00	Fall	102	11.3
4/19/2024	4182-061	Non-clipped	Spring	Fall	1.00	Fall	85	7.5
4/19/2024	4182-060	Non-clipped	Spring	Fall	1.00	Fall	86	7.5
4/19/2024	4182-062	Non-clipped	Spring	Fall	0.99	Fall	85	6.9
5/4/2024	4182-063	Non-clipped	Spring	Fall	1.00	Fall	92	8.8
5/5/2024	4182-066	Non-clipped	Fall	Fall	1.00	Fall	64	2.7
5/5/2024	4182-064	Non-clipped	Fall	Fall	1.00	Fall	75	5.0
5/5/2024	4182-065	Non-clipped	Fall	Fall	1.00	Fall	55	1.9

Appendix 9: **Monthly average fork length or total length in mm (Avg), minimum and maximum fork lengths or total lengths (Range), and sample size (*n*) for each non-salmonid species captured during the 2024 lower American River RST sampling season.**

Common Name	January Avg (Range, *n*)	February Avg (Range, *n*)	March Avg (Range, *n*)	April Avg (Range, *n*)	May Avg (Range, *n*)	June Avg (Range, *n*)
American Shad	-	-	-	-	365 (339 - 406, *n* = 3)	370 (350 - 389, *n* = 4)
Bluegill	61 (48 - 80, *n* = 6)	-	-	58 (58, *n* = 1)	90 (51 - 128, *n* = 2)	97 (52 - 141, *n* = 2)
Channel Catfish	-	-	NA (NA, *n* = 1)	-	100 (100, *n* = 1)	-
Common Carp	-	-	155 (150 - 160, *n* = 2)	-	280 (280, *n* = 1)	110 (110, *n* = 1)
Golden Shiner	-	-	55 (38 - 74, *n* = 3)	-	55 (55, *n* = 1)	78 (78, *n* = 1)
Goldfish	-	-	145 (145, *n* = 1)	-	-	-
Hardhead	55 (33 - 104, *n* = 13)	42 (42, *n* = 1)	45 (37 - 60, *n* = 7)	51 (43 - 75, *n* = 10)	47 (34 - 119, *n* = 101)	49 (26 - 73, *n* = 58)
Largemouth Bass	41 (41, *n* = 1)	-	28 (28, *n* = 1)	-	-	34 (22 - 47, *n* = 5)
Pacific Lamprey	118 (93 - 140, *n* = 151)	124 (117 - 130, *n* = 2)	119 (95 - 393, *n* = 213)	120 (98 - 421, *n* = 235)	116 (91 - 134, *n* = 195)	116 (97 - 136, *n* = 115)
Prickly Sculpin	70 (46 - 109, *n* = 14)	-	76 (62 - 98, *n* = 6)	83 (53 - 112, *n* = 2)	56 (56, *n* = 1)	85 (85, *n* = 1)
Redear Sunfish	44 (44, *n* = 1)	-	-	-	-	-
Riffle Sculpin	52 (40 - 82, *n* = 76)	47 (47, *n* = 1)	68 (55 - 81, *n* = 7)	63 (48 - 90, *n* = 12)	97 (78 - 116, *n* = 2)	65 (57 - 73, *n* = 2)
River Lamprey	159 (138 - 196, *n* = 12)	-	116 (116, *n* = 1)	-	-	-

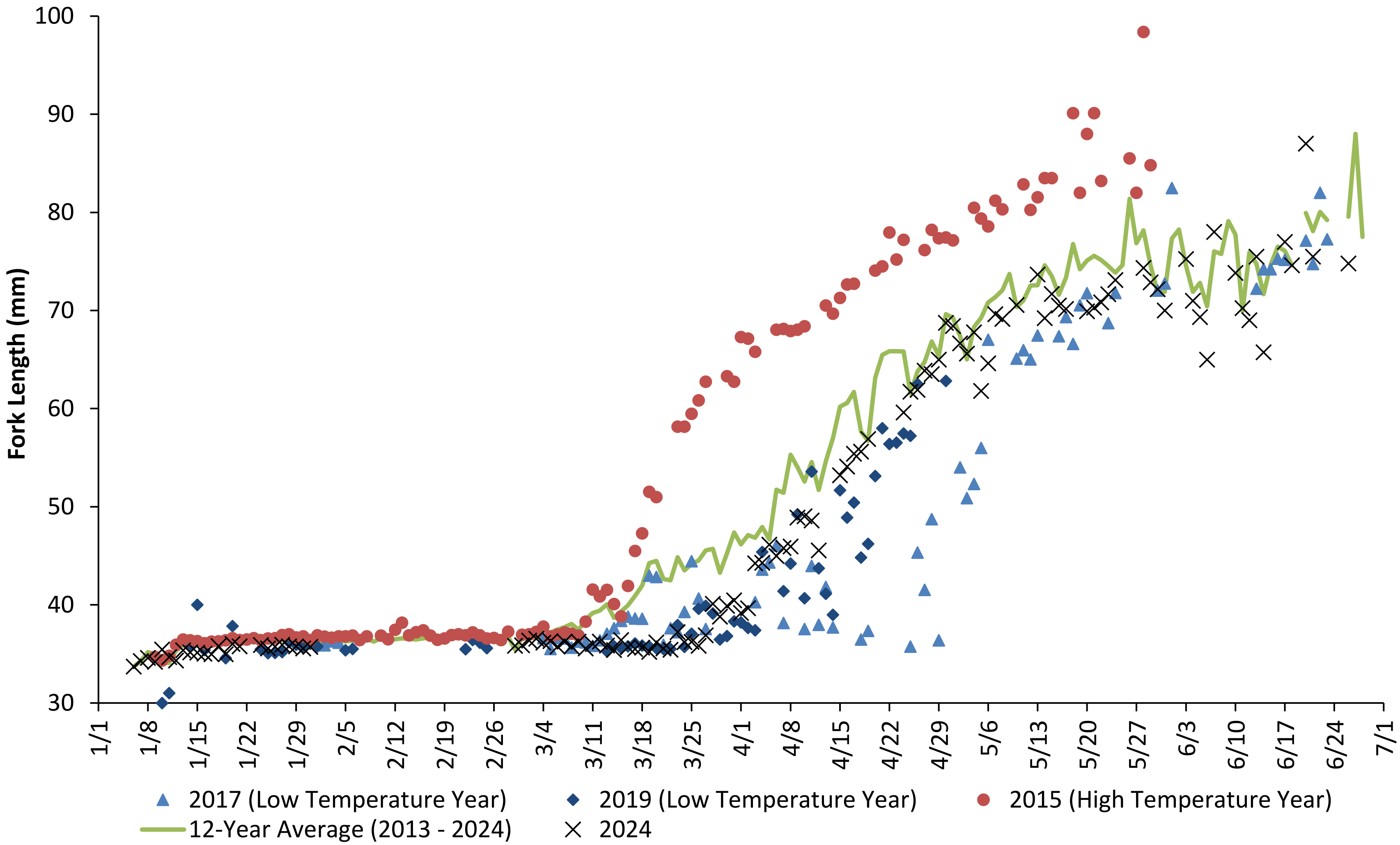
Sacramento Pikeminnow	56 (36 - 76, *n* = 2)	-	47 (29 - 55, *n* = 12)	48 (38 - 71, *n* = 13)	51 (37 - 78, *n* = 37)	54 (36 - 70, *n* = 17)
Sacramento Sucker	57 (38 - 83, *n* = 20)	-	51 (46 - 55, *n* = 2)	NA (NA, *n* = 1)	34 (23 - 53, *n* = 12)	26 (18 - 49, *n* = 54)
Spotted Bass	60 (60, *n* = 1)	-	62 (54 - 70, *n* = 2)	58 (58, *n* = 1)	-	40 (36 - 44, *n* = 3)
Striped Bass	-	-	-	-	-	NA (NA, *n* = 1)
Threadfin Shad	53 (44 - 64, *n* = 17)	50 (50, *n* = 1)	55 (37 - 64, *n* = 14)	55 (49 - 62, *n* = 5)	57 (56 - 57, *n* = 2)	-
Threespine Stickleback	37 (24 - 49, *n* = 24)	-	47 (44 - 49, *n* = 2)	44 (21 - 53, *n* = 18)	31 (20 - 54, *n* = 30)	38 (21 - 52, *n* = 11)
Tule Perch	-	-	-	86 (86, *n* = 1)	-	32 (32, *n* = 1)
Unknown bass	-	-	-	-	-	21 (16 - 36, *n* = 124)
Unknown lamprey	95 (63 - 150, *n* = 24)	92 (73 - 110, *n* = 2)	102 (36 - 134, *n* = 67)	97 (55 - 134, *n* = 78)	92 (43 - 112, *n* = 36)	91 (44 - 155, *n* = 19)
Unknown minnow	-	-	25 (25, *n* = 1)	-	26 (19 - 33, *n* = 2)	23 (19 - 30, *n* = 5)
Unknown sculpin	-	-	-	31 (31, *n* = 1)	-	25 (17 - 34, *n* = 6)
Unknown sunfish	-	-	-	-	NA (NA, *n* = 1)	97 (70 - 123, *n* = 3)
Wakasagi	91 (71 - 105, *n* = 7)	-	73 (53 - 103, *n* = 10)	53 (49 - 55, *n* = 5)	65 (65, *n* = 1)	-
Western Mosquitofish	35 (35, *n* = 1)	-	-	-	-	-

Appendix 10: Trap efficiency trials included for data analysis as a function of discharge (cfs) measured at Fair Oaks at the time of release for the lower American River RSTs from 2013 through 2024.

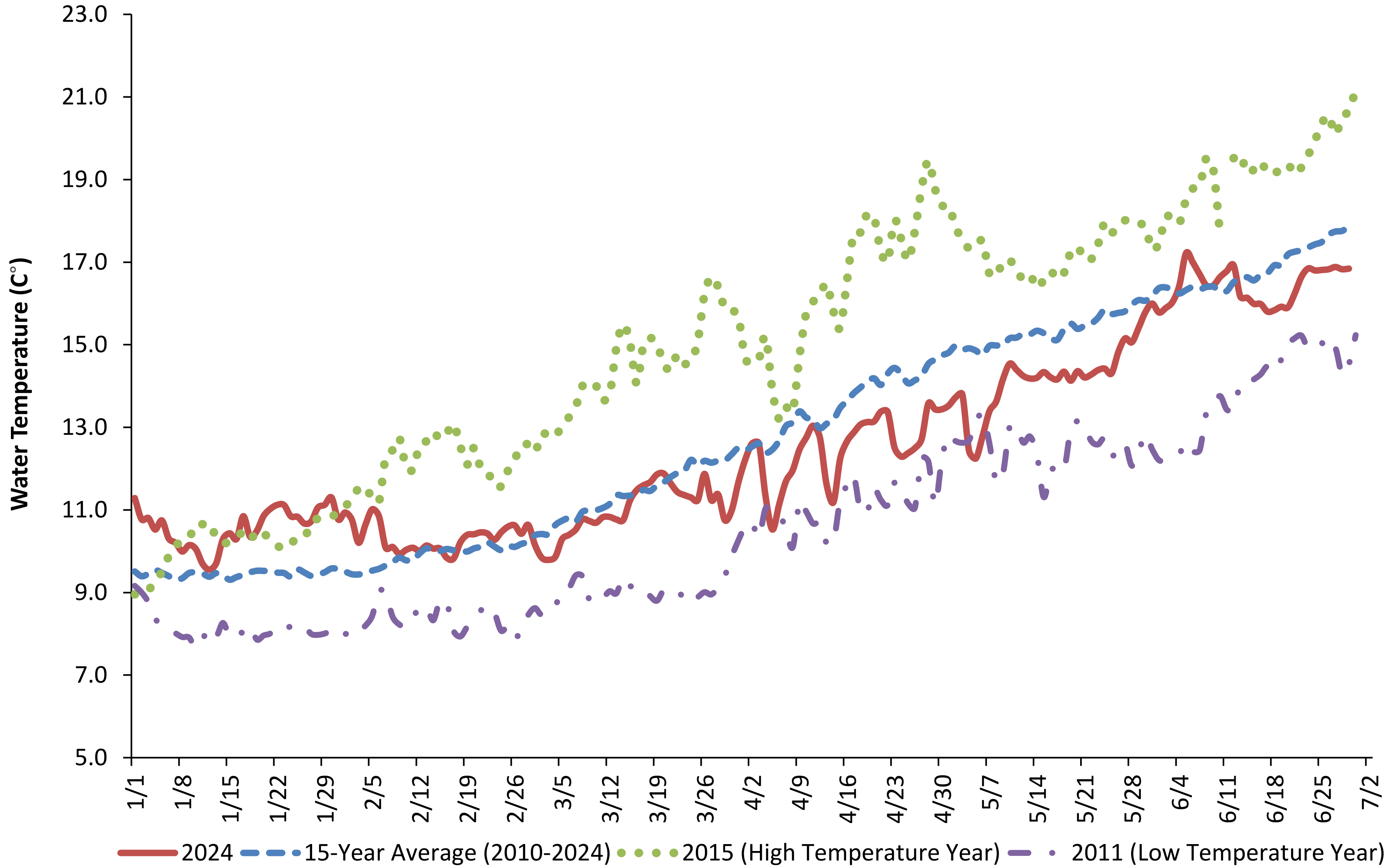


Discharge (cfs)	*n*	Trap Efficiency Avg (range)
< 600	13	21.7% (7.8% - 34.2%)
600 - 999	16	16.7% (4.4% -28.8%)
1,000 - 1,999	22	10.2% (1.9% - 21.7%)
2,000 - 4,999	15	5.7% (2.1% - 13.5%)
>= 5000	14	1.8% (0.4% - 5.6%)

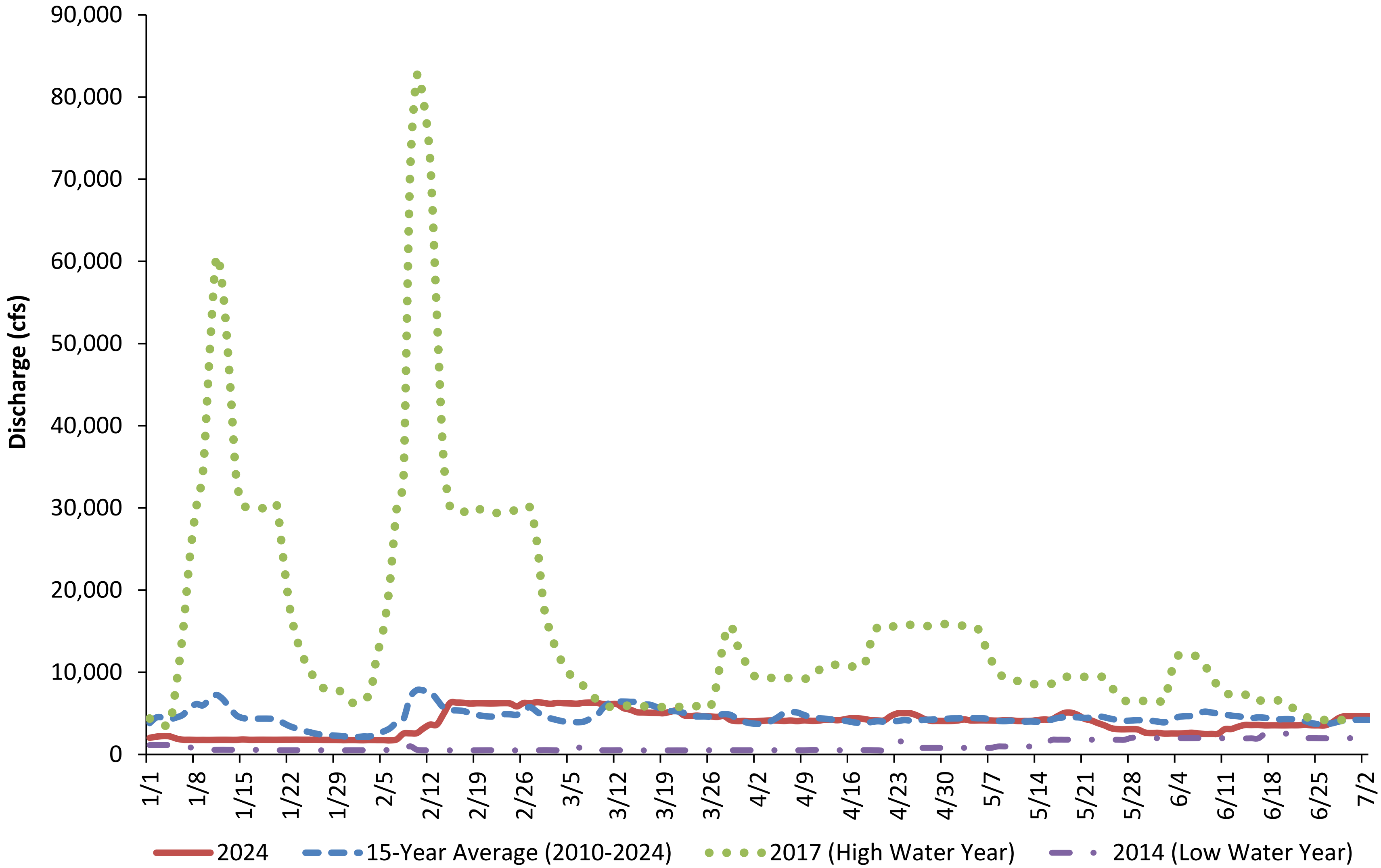
Appendix 11: **Daily average fork length (mm) of fall-run Chinook Salmon from 2013 – 2024, a high-water temperature year in 2015 (red round dots), a low water temperature year in 2017 (blue triangles), a low water temperature year in 2019 (blue diamonds), the 12-year average (green line), and the current year (2024, black X's).**



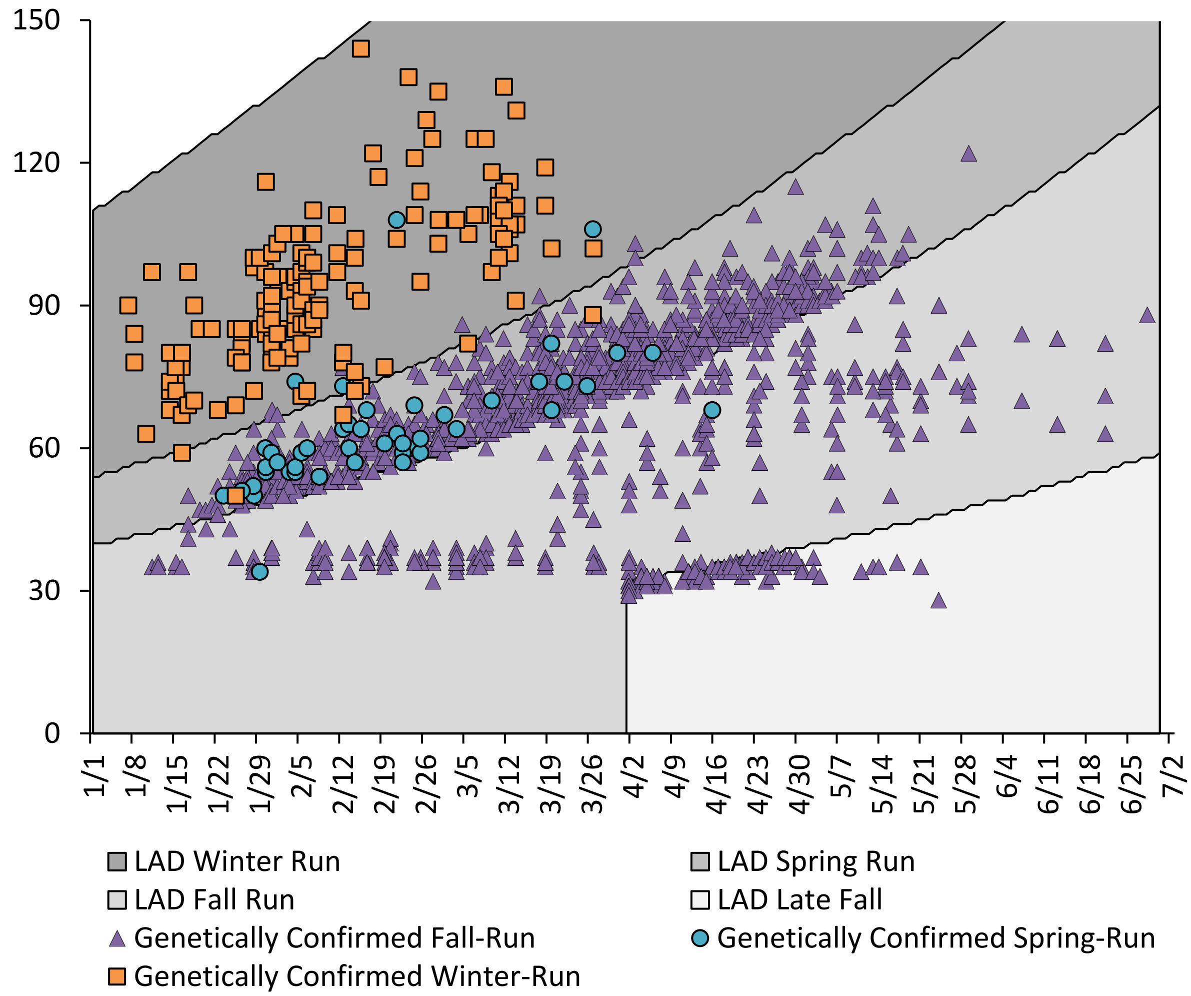
Appendix 12: **Daily average water temperatures (C) in the lower American River at Watt Avenue for the 15 year period 2010 - 2024, the highest temperature year (green round dots), lowest temperature year (purple dash dots), the 15-year average (blue dashes) and the current year (2024, red line). Data from USGS station number 11446980.**



Appendix 13: **Daily average discharge (cfs) on the lower America River at Fair Oaks for the 15-year period 2010 – 2024, the highest water year (green round dots), the lowest water year (purple dash dots), 15-year average (blue dashes) and the current year (2024, red line). Data from USGS station number 11446500.**



Appendix 14: **Daily fork length distribution of SNP genetically sampled natural origin Chinook Salmon captured in the lower American River RSTs from 2015 through 2024.**



LAD Run Assignment	SNP Confirmed Fall Run	SNP Confirmed Late Fall Run	SNP Confirmed Spring Run	SNP Confirmed Winter Run
Fall	266	0	2	0
Late Fall	99	0	0	0
Spring	943	0	40	7
Winter	8	0	4	159