# Juvenile Salmonid Emigration Monitoring in the Lower Stanislaus River at Caswell Memorial State Park, California

## January – June 2024


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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** | Cramer Fish Sciences |
| **cfs** | cubic feet per second |
| **CI** | Confidence Interval |
| **CVPIA** | Central Valley Project Improvement Act |
| **DNA** | Deoxyribonucleic acid |
| **DO** | dissolved oxygen |
| **ESA** | Endangered Species Act |
| **FL** | fork length |
| **g** | gram |
| **GVL** | UC Davis Genomic Variation Laboratory |
| **m/s** | meters per second |
| **mg/L** | milligrams per liter |
| **mm** | millimeter |
| **NMFS** | National Marine Fisheries Service |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **NTU** | Nephelometric Turbidity Units |
| **PSMFC** | Pacific States Marine Fisheries Commission |
| **RPM** | revolutions per minute |
| **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 Stanislaus River at Caswell Memorial State Park 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, the 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*. Secondary objectives of trapping operations focus on recording 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 at Caswell Memorial State Park on the lower Stanislaus River in California. The San Joaquin Water Index classified the 2024 water year as above normal, with moderate discharge and environmental conditions experienced throughout the 2024 sampling season. Sampling occurred on 164 days of the 175-day season (94%) beginning January 6 and concluding on June 28. Following genetic analysis, it was determined that a total of 6,080 fall-run Chinook Salmon were captured. Additionally, one hatchery origin *O. mykiss* was captured. 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 with trap efficiencies ranging from 0.26% to 5.19%. The CAMP RST Platform Mark-Spline Model estimated a total fall-run Chinook Salmon passage of 452,900 (95% confidence interval: 364,700 to 586,300) at the Stanislaus River at Caswell Memorial State Park rotary screw traps. Passage estimates for *O. mykiss* and non-salmonid fish taxa were not assessed due to minimal catch.

This annual report also includes 13 appendices to describe different environmental variables and studies related to the trap site or rotary screw trap operations during the 2024 sampling season.

# Introduction

The Stanislaus River is a tributary to the San Joaquin River, one of two mainstem rivers of California's Central Valley watershed. This watershed once supported large populations of Chinook Salmon *Oncorhynchus tshawytscha* and steelhead *O. mykiss*, the anadromous form of Rainbow Trout. Historically the Stanislaus River supported three runs of Chinook Salmon, including fall (fall-run), spring (spring-run), and late fall (late fall-run) Chinook Salmon (Yoshiyama et al. 2001). However, the construction of impassable dams throughout the valley, flat-lining of flows, disconnection of floodplains, hydraulic mining, over-harvesting, introducing predatory species, water diversions and other factors have contributed to the widespread decline of salmonid populations (Lindley et al. 2006; NMFS 2019). As a result, spring-run Chinook Salmon and California Central Valley steelhead were listed as threatened under the Endangered Species Act (ESA) by the National Marine Fisheries Service (NMFS) which is a part of the National Oceanic and Atmospheric Administration (NOAA) (NMFS 2014). California Central Valley fall-run Chinook Salmon and late fall-run Chinook Salmon are both species of special concern.

Congress passed the Central Valley Project Improvement Act (CVPIA) in 1992 to mitigate for the loss of anadromous fish habitat that resulted from the construction and operation of the Central Valley Project (CVPIA 1992). The Fish Resource Area of the CVPIA includes all provisions under section 3406(b) to improve natural production of anadromous fish in Central Valley rivers and streams. The Anadromous Fish Restoration Program (AFRP) was established by the United States Fish and Wildlife Service (USFWS) pursuant to section 3406(b) with goals of sustainably increasing the natural production of anadromous fishes in California's Central Valley streams. The Comprehensive Assessment and Monitoring Program (CAMP) was developed to evaluate the effectiveness of strategies intended to reach goals set by the CVPIA and AFRP. Juvenile salmonid monitoring on the Stanislaus River using rotary screw traps (RSTs) helps meet the objectives set by AFRP and CAMP.

There are two sites where RST monitoring efforts have occurred on the lower Stanislaus River; Oakdale (river kilometer [rkm] 64.5) and Caswell Memorial State Park (rkm 13.8). However, there was no sampling at Oakdale in 2024 due to a lack of funding, and no funding has been planned for future RST operation at Oakdale. These sampling efforts, defined by the CVPIA and NMFS Reasonable and Prudent Actions, monitor juvenile salmonids to provide current data to the CVPIA Science Integration Team and have been conducted since 1993 by California Department of Fish and Wildlife (CDFW), the USFWS, Cramer Fish Sciences (CFS), FISHBIO Consultants, or the Pacific States Marine Fisheries Commission (PSMFC). PSMFC has been the sole operator at Caswell Memorial State Park since 2017.

The lower Stanislaus River RSTs at Caswell Memorial State Park monitor juvenile salmonid abundance to help determine if habitat restoration activities and flow management practices are resulting in a positive impact for Chinook Salmon and *O. mykiss* production. Furthermore, this report presents data that describes the size and abundance of other native and non-native fish species in relation to the time of year, river discharge, and environmental conditions.

# Study Area

The Stanislaus River headwaters begin on the western slope of the Sierra Nevada mountain range and covers an area of about 1,195 square miles (NOAA 2020). The upper Stanislaus River consists of three forks (North, Middle and South) and tributaries which flow southwest into New Melones Reservoir. The lower Stanislaus River is a major tributary to the San Joaquin River in the southern portion of California's Central Valley watershed and flows north joining the Sacramento River in the Sacramento-San Joaquin Delta. The lower Stanislaus River is 96.6 rkms long from the base of Goodwin Dam to the confluence of the San Joaquin River and provides spawning and rearing habitat for Chinook Salmon and Central Valley steelhead. Suitable spawning habitat exists between Goodwin Dam (rkm 94) and Riverbank (rkm 54.7) while downstream areas are predominately sand substrate (KDH 2008).

The lower Stanislaus River is regulated by three dams; New Melones Dam, Tulloch Dam, and Goodwin Dam (Figure 1, Figure 2). These dams are operated by the United States Bureau of Reclamation (USBR) and the Tri-Dam Project to provide flood control, irrigation for agricultural use, power generation, temperature regulation, and for water quality improvement in the lower San Joaquin River (NMFS 2019). Goodwin and Tulloch Dam are equally and jointly owned by the Oakdale Irrigation District and the South San Joaquin Irrigation District. The construction of Melones Dam in 1926 and New Melones Dam in 1966 was believed to have been a factor in the extirpation of the spring-run Chinook Salmon historically supported by the Stanislaus River (Yoshiyama et al. 2001).

The trapping site at Caswell Memorial State Park (rkm 13.8) was determined in 1993 to be the furthest location from the spawning area that allowed for trap deployment, access, and maintained flows consistent enough to operate RSTs (CFS 2006). Two 8-foot diameter RSTs were positioned in the thalweg of the channel near the furthest northeast corner of the state park. The traps were designated as Trap 1 and Trap 2, with Trap 1 set closer to the southwestern bank of the river and Trap 2 set closer to the northeastern bank of the river (Figure 3). Access to the trapping site was gained through a private road.

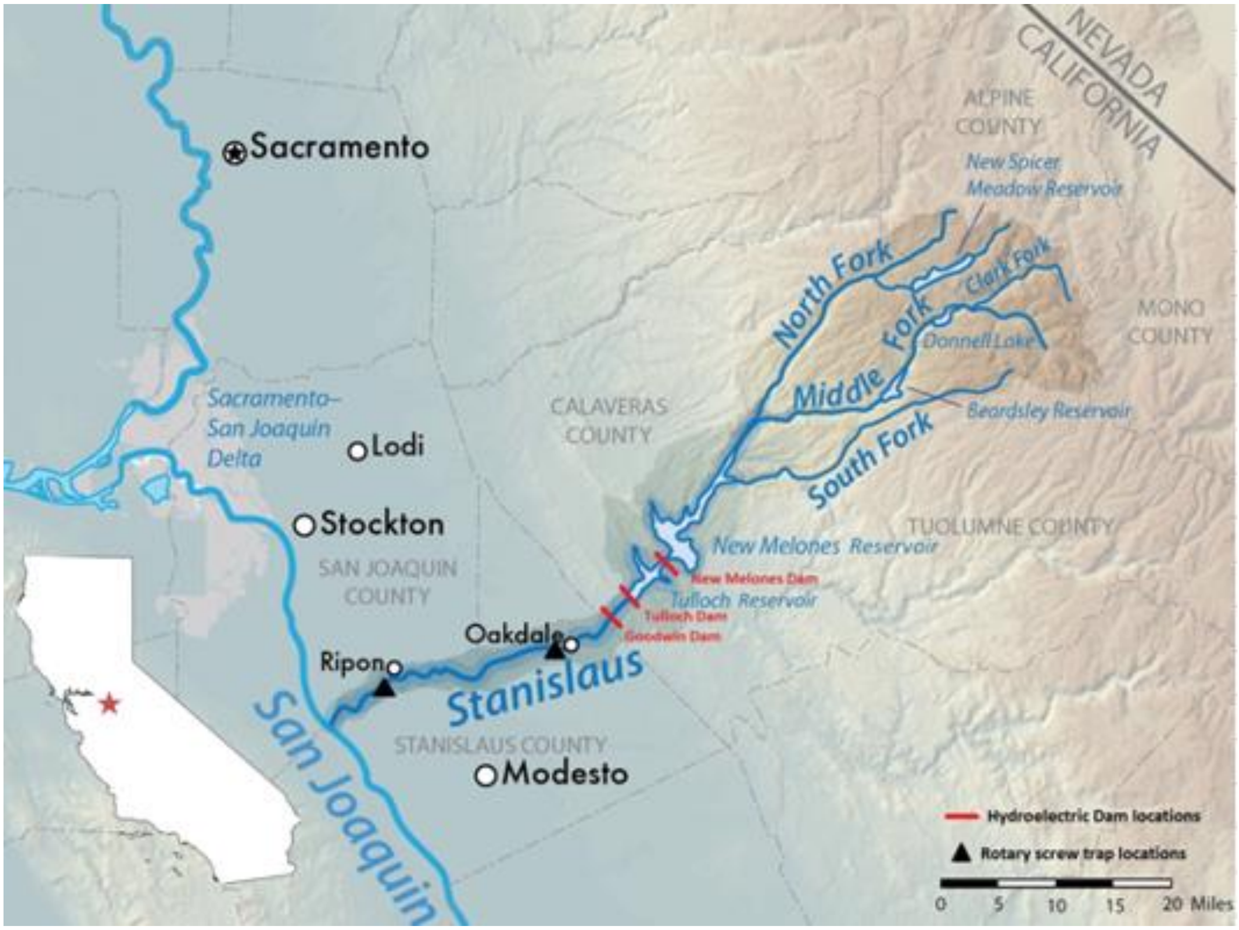


**Figure 1: Map of the Stanislaus River and rotary screw trap sites at Caswell Memorial State Park and Oakdale. Inset map illustrates the Stanislaus River in the state of California.**

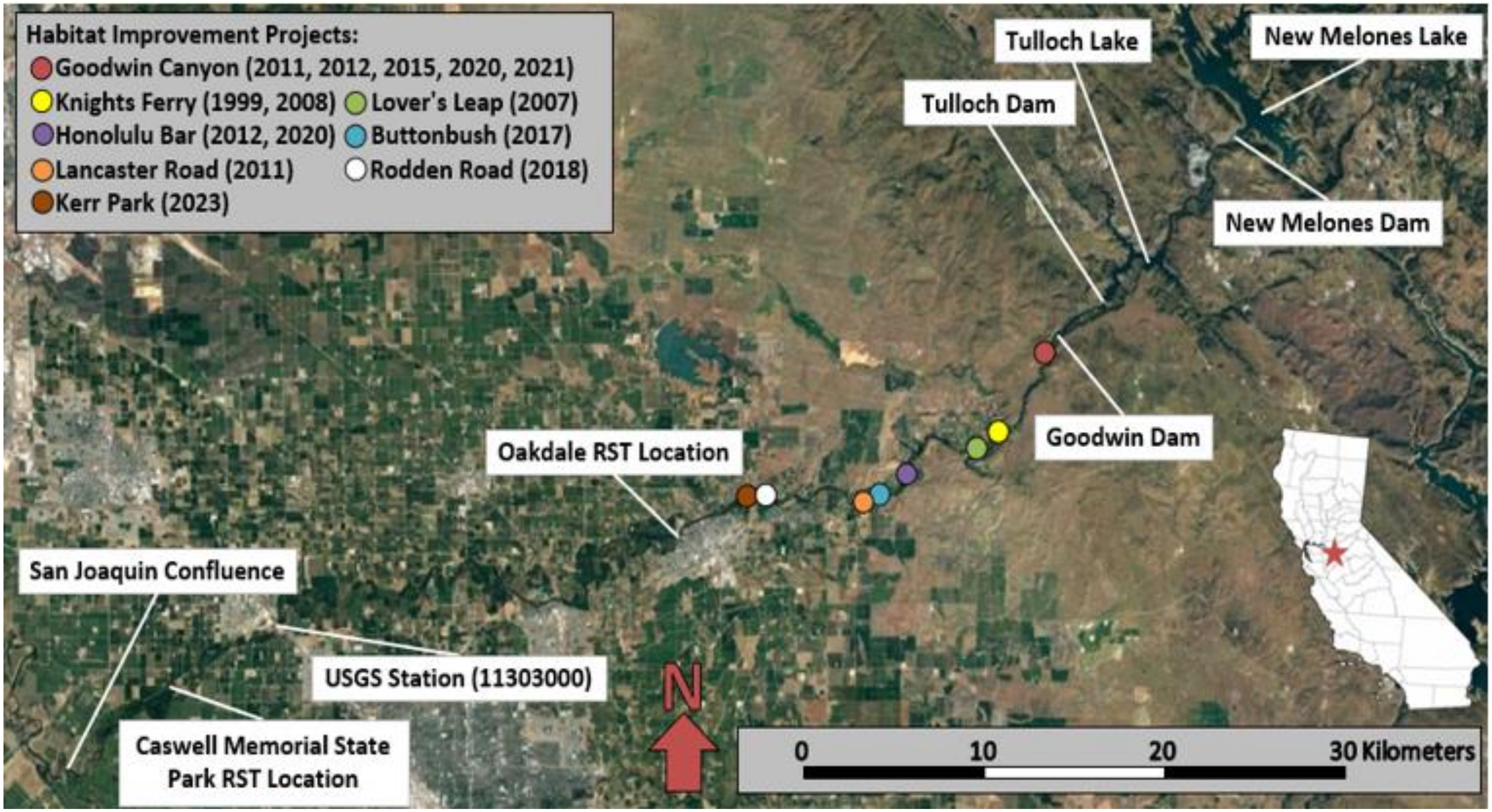


**Figure 2: Points of interest on the Stanislaus River.**

# Methods

## Safety Measures

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

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.

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 upstream and downstream of the traps. Solar powered amber strobe lights, that automatically turn on in low light conditions, were attached to the outermost railings on each trap to alert the public at night of the navigational hazard. Reflective orange 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 late 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 a side-by-side configuration and designated as Trap 1 and Trap 2 (Figure 3). The traps were anchored with a 0.95 cm galvanized cable secured to a tree upstream with the cable bridle attached to the outermost pontoon of each trap. An anchor rope was attached to the southwestern bank, allowing for in-channel adjustments and to pull the traps to shore. Once crew members and field sampling gear were on board, the traps were then released back out into the thalweg to continue sampling while the crew collected environmental data and cleared the live wells.

New in 2024, a debris barrier was constructed to deflect large woody debris. Two 20-foot long, 12-inch-diameter Low Head irrigation pipes (JM Eagle) were partially filled with river water and capped at both ends. The capped pipes were then joined at one end, and the other ends were attached to the outermost pontoon of each RST, forming a triangular shape in front of the RSTs.

Trap checks were conducted at least once every 24 – 28 hours while traps were actively sampling in the cone-down configuration. During large storms 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 instances where storms, flow increases, or debris loads were deemed severe enough, traps were taken out of service until conditions improved.

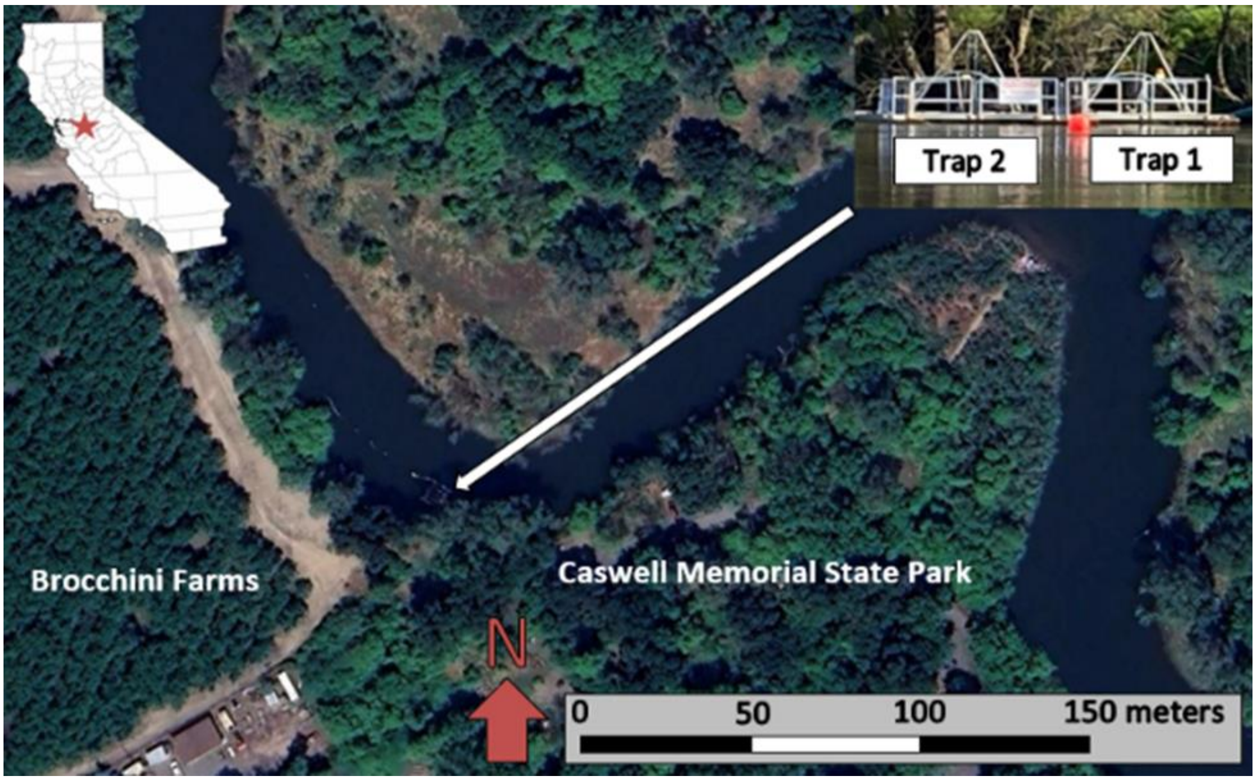


**Figure 3: Stanislaus River RST site at Caswell Memorial State Park, captured by Google Earth in May of 2023. Inset image illustrates the side-by-side trap configuration.**

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 (RPM) was recorded. Subsequently, intakes were checked and recorded as “clear,” “partially blocked,” “completely blocked,” or “backed up into cone.” If the trap was not functioning upon arrival, the trap was restored to its normal function without raising the cone. After collecting environmental data and clearing the trap, time and total cone rotations were recorded using a mechanical lever actuated counter (Trumeter Company Inc.) attached to the port side pontoon or by an electric hubodometer (Veeder-Root TR 1000-000) mounted to the axel inside of the live well on each trap.

## Environmental Parameters

During trap visits, various environmental parameters were recorded at least once per visit. Temperature (degrees Celsius [C]) and dissolved oxygen (DO; milligrams per liter [mg/L]) were measured using a YSI Ecosense DO200A 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 units [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 centimeter 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]) and average daily river temperature (C) were calculated from instantaneous measurements recorded 11.6 rkm upstream of the RSTs from the United States Geological Survey (USGS) Stanislaus River at Ripon monitoring station (USGS station number 11303000, Figure 2). Daily average spill at Goodwin Dam was retrieved from the USBR GDW gauge to display changes in discharge at Ripon that were caused by inputs below Goodwin Dam.

## 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 work station 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.**

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-run (Greene 1992). Additionally, salmonids were assessed for marks. Ultimately, fish were separated into different buckets for: 1) all spring-run Chinook Salmon, 2) all *O. mykiss*, 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 presumed to be hatchery origin.

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 using 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 spring and fall-runs of Chinook Salmon, *O. mykiss*, and non-salmonid species captured for each trap on the Stanislaus River.**

| | Spring Chinook | Fall Chinook | *O. mykiss* | Hatchery Salmonids | Recaptured Chinook | Non-Salmonid Species |
|---|---|---|---|---|---|---|
| Enumerate | All | All | All | All | All | All |
| Life Stage | 50 | 100 | 100 | 50 | 50 | 50 |
| Measure | 50 | 100 | 100 | 50 | 50 | 50 |
| Weigh | 25 | 100 | 25 | 0 | 0 | 0 |
| Mortality | All | All | All | All | All | All |

## Fish Processing

Fish were processed on the riverbank adjacent to the traps where there was adequate shade and secluded from the general public. A fish processing station was 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). Species that were identified through the length-at-date criteria as ESA listed (spring-run) and natural origin *O. mykiss* 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 sample size varied by measurement, 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 assigned 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 hatchery origin 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 difficult. In those cases, mortalities were considered to be a "mort plus-count". Genetic samples were collected for a subsample of LAD fall 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 O. mykiss adapted from USFWS (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<br>* Seam along mid-ventral line visible<br>* Pigmentation undeveloped |
| 3 | Parr | * Seam along mid-ventral line not visible<br>* Scales firmly set<br>* Darkly pigmented with distinct parr marks<br>* Minimal silvery coloration |
| 4 | Silvery Parr | * Parr marks visible but faded<br>* Intermediate degree of silvering |
| 5 | Smolt | * Parr marks highly faded or absent<br>* Bright silver or nearly white coloration<br>* Scales easily shed (deciduous)<br>* Black trailing edge on caudal fin<br>* Body/head elongating |
| 6 | Adult | * ≥ 300mm |

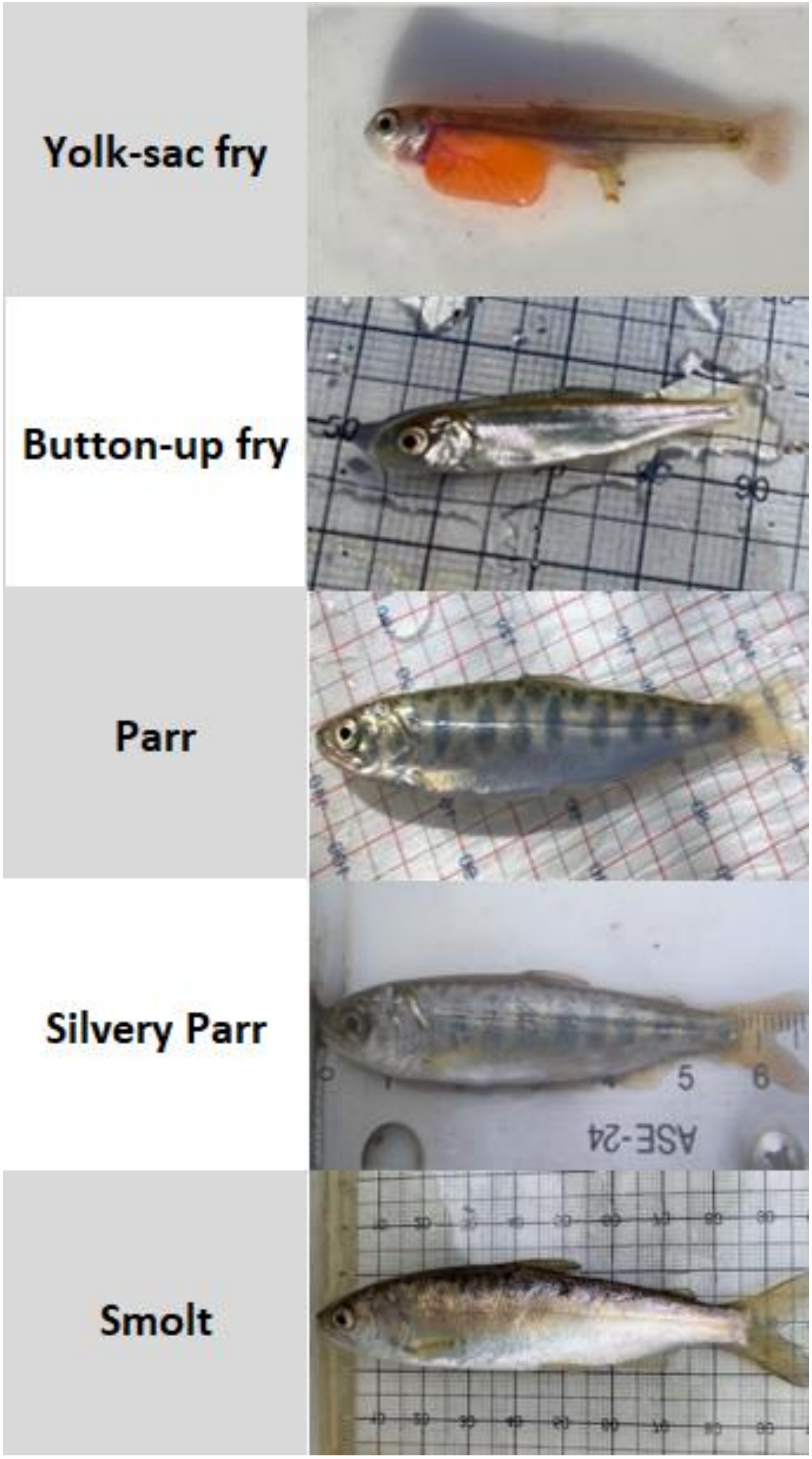


**Figure 6: Examples of life stages for Chinook Salmon according to the smolt index rating.**

## 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. Up to 11 fin clips per week were taken from LAD fall-run, late fall-run, and spring-run Chinook Salmon.

Each fin clip sample was split, with half the sample sent to the CDFW Tissue Archive for storage and the other half to the 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 (deoxyribonucleic acid) 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 spring-run and late fall-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 2017 – 2023).

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 an estimate of 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 at Caswell Memorial State Park. 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 55 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 2).

**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 the majority of the Chinook Salmon had a fork length greater than 55 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 overnight until 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: A Chinook Salmon marked with a pink VIE tag on the snout.**

At least 300 Chinook Salmon were used to conduct each trap efficiency trial with BBY stain or VIE tags. When daily catch totals were too low, Chinook Salmon were provided by CDFW's Merced River Hatchery.

The trap efficiency release site was approximately 0.5 rkm upstream of the traps. Marked salmon were released off the bow while rowing an inflatable boat to evenly scatter fish across the width of the river in small groups using dip nets to avoid schooling during release. All releases occurred close to twilight to minimize depredation.

On trap visits following a 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 the 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 but 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:* $$\text{Hours Fished} \times \text{Revolutions (per hour)} = \text{Estimated Total Revolutions}$$

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

*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 *O. mykiss* 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 10 trials were conducted and included in analysis, 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 those sampling periods. 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 are operated during a sampling season, passage estimates are calculated for each trap, and subsequently, those passage estimates from each trap are averaged together to provide a total estimated passage.

## Confidence Interval Estimates

Confidence intervals (CIs) 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 per trap that were 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

Trap 1 and Trap 2 began sampling on January 6, 2024, and concluded June 28, 2024, with 164 days of sampling effort in the 175-day season (94%; Figure 9). Of the 164 days of sampling effort, Trap 1 sampled successfully for approximately 3,403 hours (87%) and sampled unsuccessfully for approximately 500 hours (13%; Figure 10), while Trap 2 sampled successfully for approximately 3,832 hours (93%) and sampled unsuccessfully for approximately 310 hours (7%; Figure 11). Unsuccessful sampling was a consequence of debris stopping the trap from spinning at the entrance of the cone or intakes to the live well. To mitigate trap stoppages caused by debris, a debris barrier was installed on January 17, 2024. Before the debris barrier was installed (January 6 – 17, 2024), the RSTs had a collective sampling success rate of 71%. After the installation, the sampling success rate increased to 92% for the remainder of the sampling season (Figure 10 and Figure 11). Over the course of the season, sampling of both traps was suspended for a total of 11 days with no outages greater than seven days. This included suspending sampling operations for weekend shutdowns in June (*n* = 6 days) and high wind and heavy rain in early February (5 days).

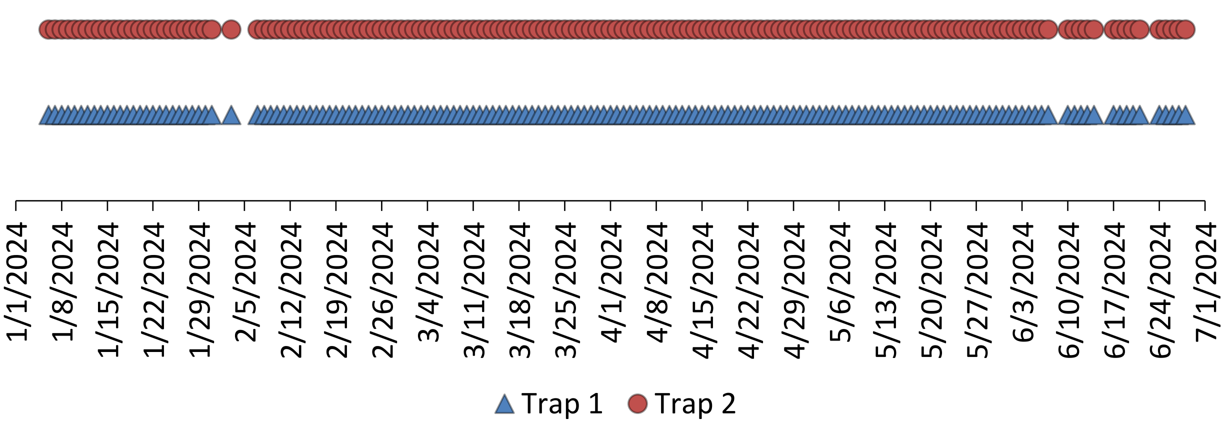


**Figure 9: Dates sampling occurred for each trap during the 2024 Stanislaus RST sampling season.**

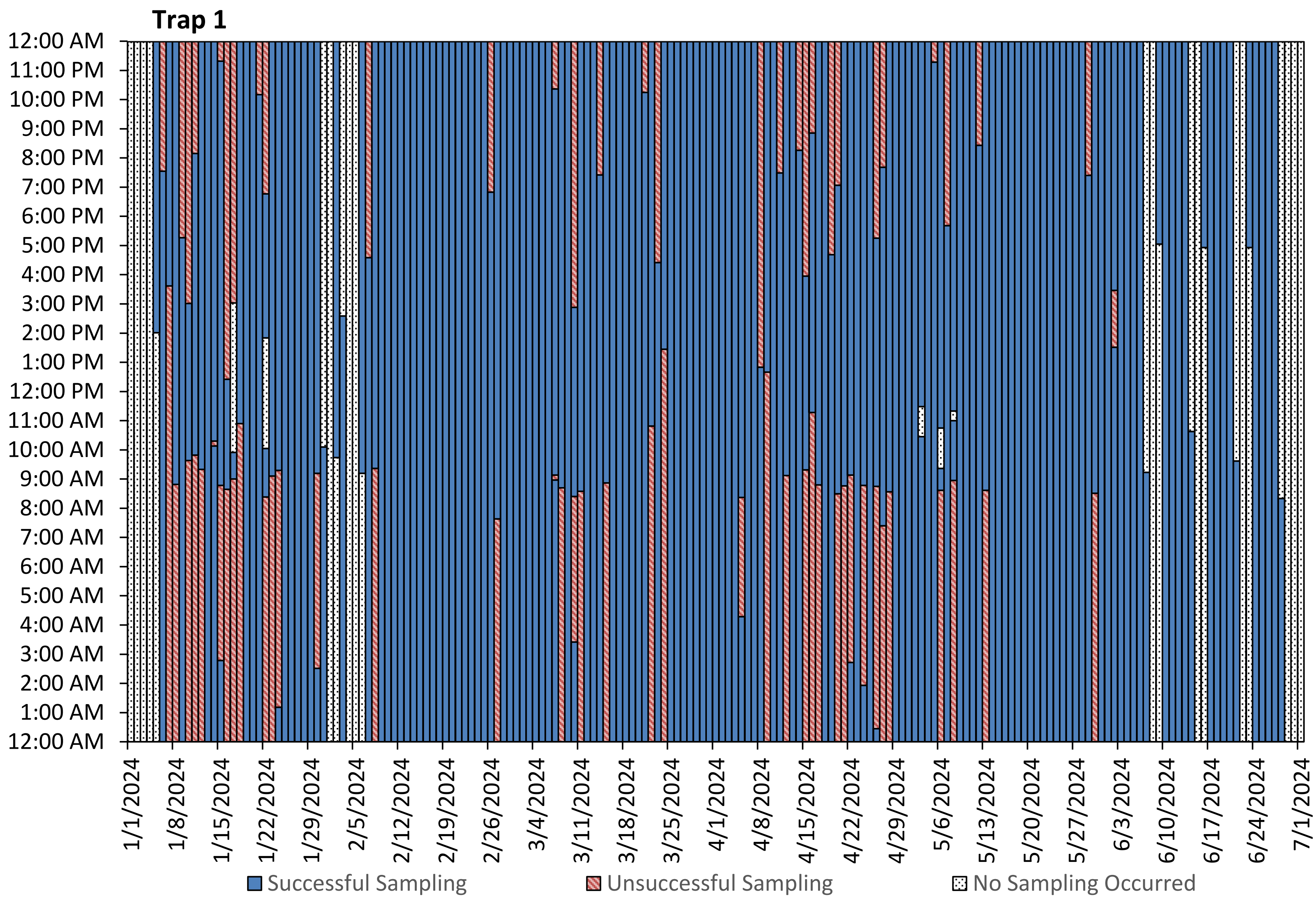


**Figure 10: Daily hours Trap 1 sampled successfully, sampled unsuccessfully, or did not sample during the 2024 Stanislaus River RST sampling season.**

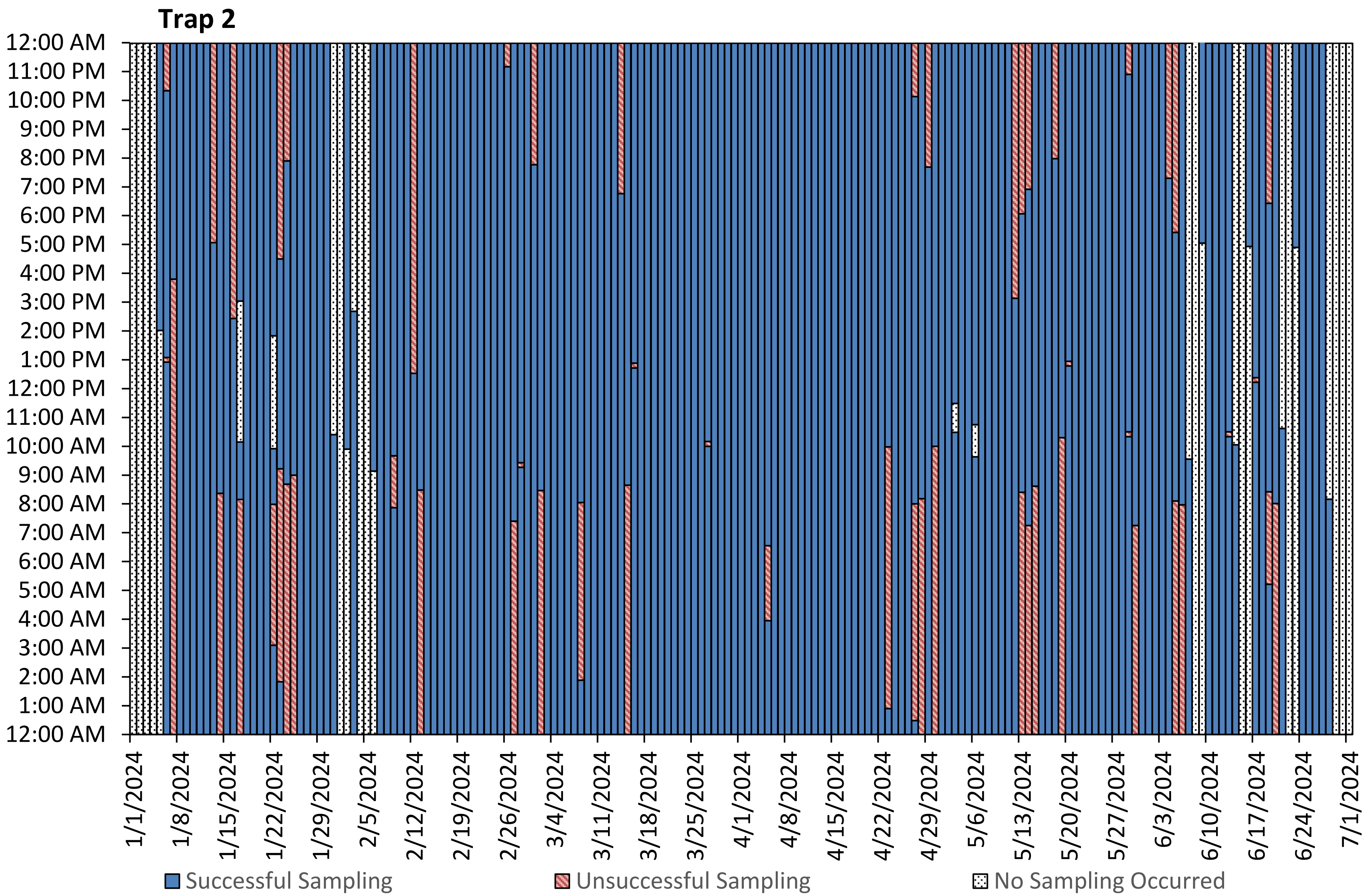


**Figure 11: Daily hours Trap 2 sampled successfully, sampled unsuccessfully, or did not sample during the 2024 Stanislaus River RST sampling season.**

## Environmental Summary

The 2024 sampling season was met at times with high and variable flows, evidently, resulting in small gaps in environmental data collection. The 2024 water year was slightly above normal with occasionally high flows, therefore environmental parameters remained relatively ordinary when compared with previous years (CDWR 2024; Appendix 1). 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 maximum on June 27 and a minimum on January 6 (range: 211 – 2,550 cfs; Figure 12). Instantaneous river temperature, also recorded in 15-minute intervals by USGS at the Ripon gauge station, recorded a maximum temperature on June 11 and minimum on January 12 (range: 8.4 – 18.6 °C; Figure 12).

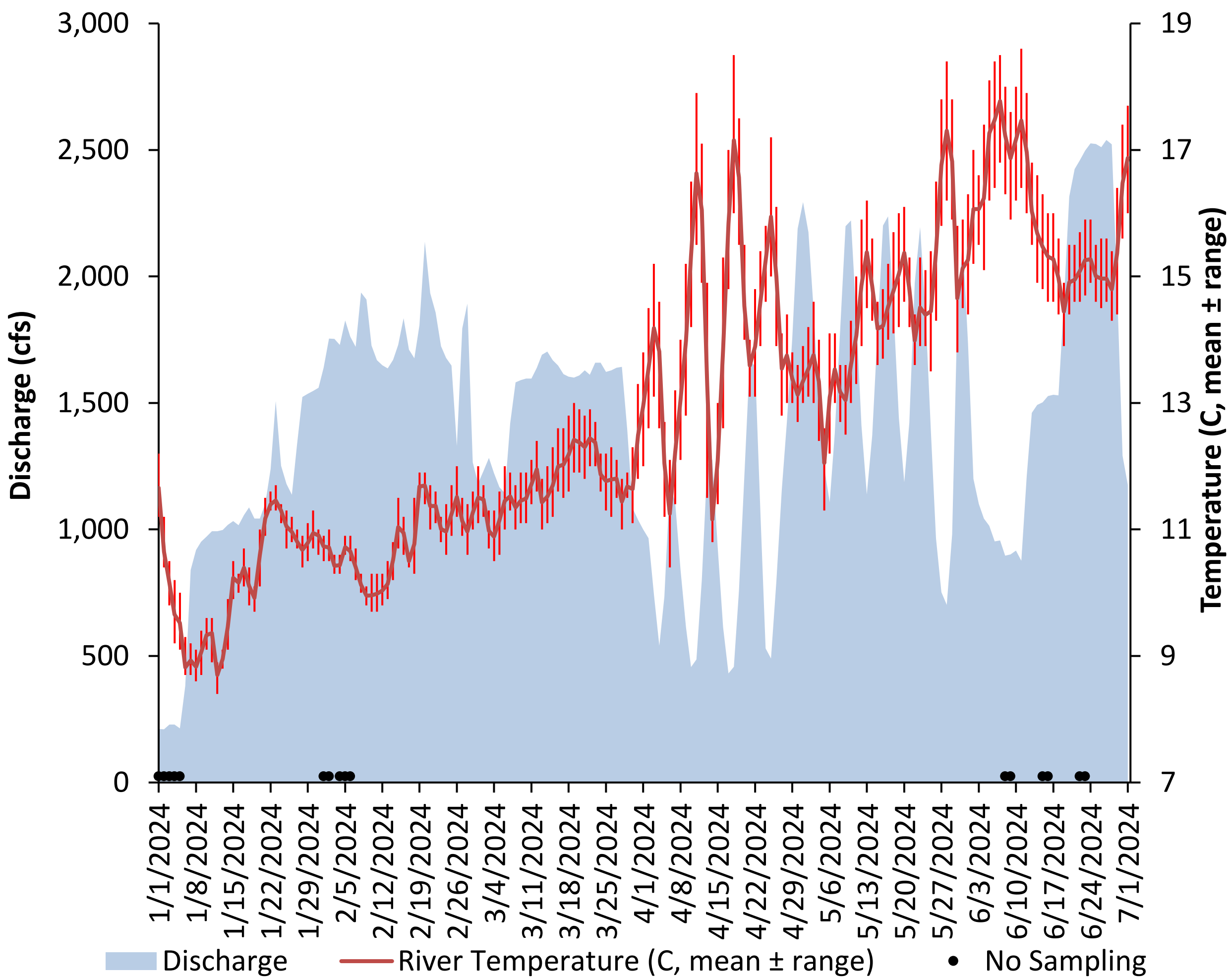


**Figure 12: Daily average discharge (cfs) and the daily minimum, maximum, and average water temperature (C) measured at Ripon, and dates no sampling occurred during the 2024 Stanislaus River RST sampling season.**

Velocity, turbidity, and DO were measured during trap visits throughout the sampling season (Figure 13). Water velocity for Trap 1 ranged from 0.10 – 0.80 m/s, while Trap 2 had a range of 0.30 – 1.00 m/s. The mean velocity for Trap 1 and Trap 2 was similar at 0.40 and 0.50 m/s, respectively. Mean difference in velocity between Trap 1 and Trap 2 was 0.18 m/s likely due to Trap 2 fishing a closer proximity to the thalweg than Trap 1. Turbidity for Trap 1 reached a minimum on January 29 and a maximum on February 20 with a range of 0.64 – 41.10 NTU. Turbidity for Trap 2 reached a minimum on January 15 and a maximum on February 20 with a range of 1.16 – 43.30 NTU. The mean turbidity for Trap 1 and Trap 2 was similar at 5.03 and 4.85 NTU, respectively. Mean difference in turbidity between Trap 1 and Trap 2 was 0.19 NTU, likely due to Trap 1's closer proximity to an eddy towards the southern bank of the river. DO reached a minimum on April 18 and a maximum on January 19 with a range of 8.38 – 11.89 mg/L.

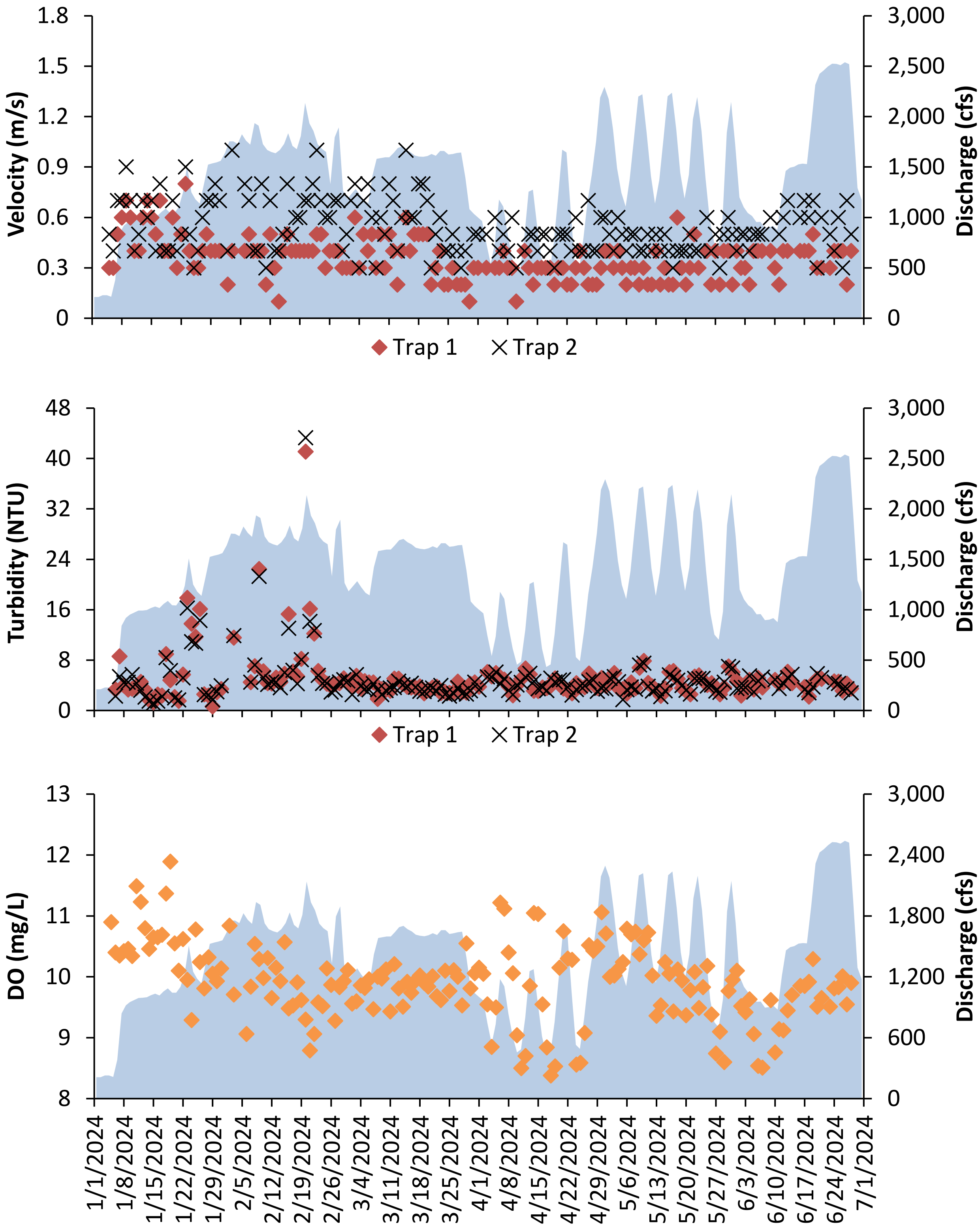


**Figure 13: Daily average velocity (m/s) and turbidity (NTU) for both traps, DO (mg/L), and discharge (cfs; measured at Ripon), during the 2024 Stanislaus River RST sampling season.**

## Catch

The two RSTs deployed during the 2024 sampling season captured 6,080 natural origin salmonids presumed to be natural origin, one hatchery produced salmonid, and 93 recaptured Chinook Salmon. The trap furthest from the thalweg, Trap 1, captured 41.9% (*n* = 2,546) of these salmonids, while Trap 2 captured 58.1% (*n* = 3,535). Additionally, 813 non-salmonid fishes were captured with 808 identified to at least the family level (Appendix 2).

## Fall-run Chinook Salmon

A total of 6,080 natural origin fall-run Chinook Salmon were captured during the 2024 sampling season. Because these fish did not have an adipose fin clip, they were presumed to be of natural origin. Catch of fall-run peaked on February 20, when 11% (*n* = 668) of these fish were captured (Figure 14). Of all fall-run captured during the 2024 sampling season, 1,366 were classified as unmeasured plus-count tallies.

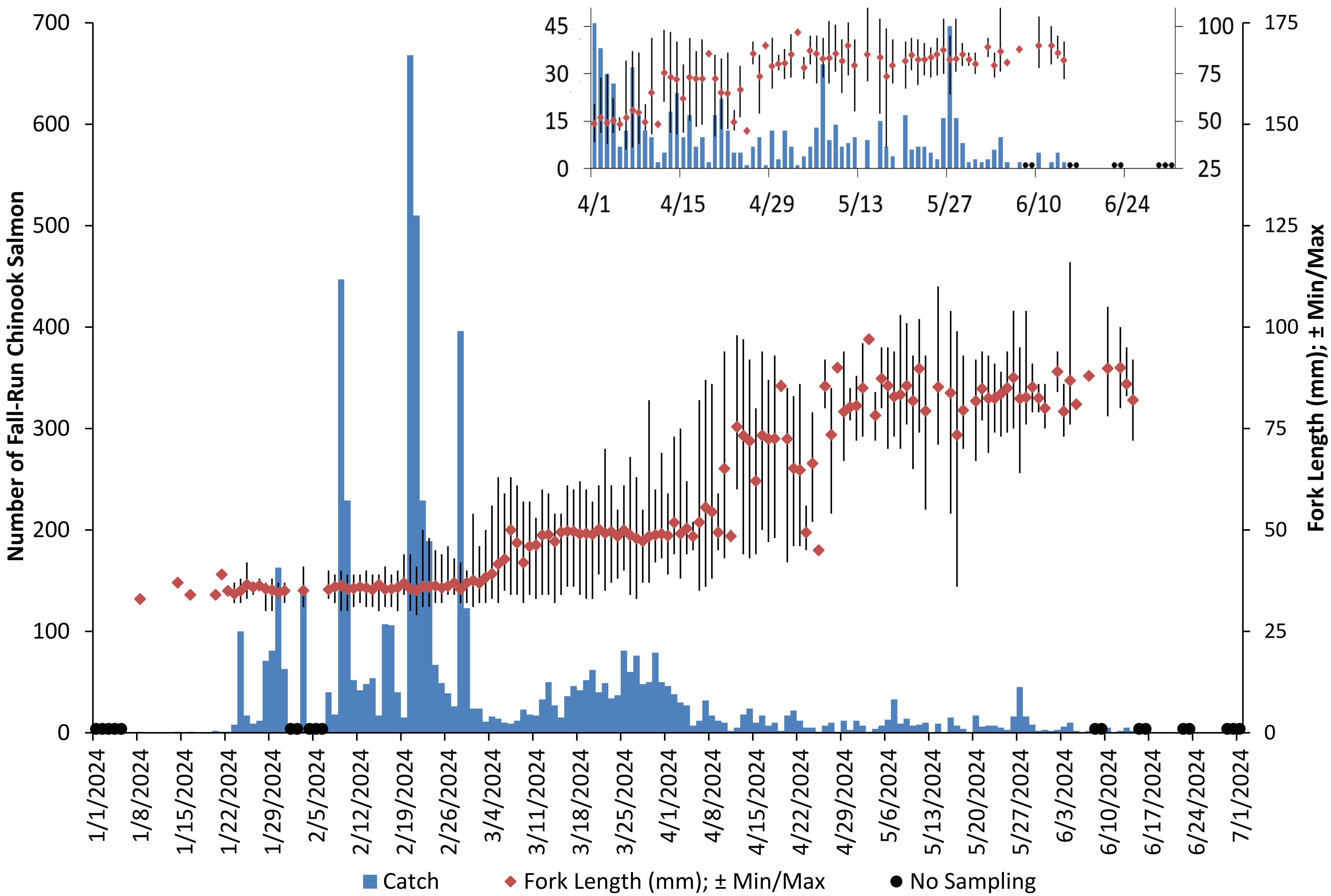


**Figure 14: Daily minimum, maximum, and average fork length (mm) and total catch of natural origin fall-run Chinook Salmon during the 2024 Stanislaus River RST sampling season.**

A total of 4,714 natural origin fall-run were measured for fork length (Table 3). The lowest weekly average fork length of 35 mm was observed the first four weeks of sampling. The smallest natural origin fall-run was 29 mm and was observed on February 21. Fork lengths slowly increased throughout the season with the weekly average reaching a maximum of 87 mm the week of June 11 (Table 3, Figure 14 Figure 15). The largest natural origin fall-run was 116 mm and was observed on June 4.

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

| Julian Week | Avg | Range | *n* | St. Dev. |
|---|---|---|---|---|
| 1/1 - 1/7 | - | - | - | - |
| 1/8 - 1/15 | 35 | 33 - 37 | 2 | 2.83 |
| 1/15 - 1/21 | 35 | 33 - 39 | 4 | 2.63 |
| 1/22 - 1/28 | 35 | 30 - 42 | 218 | 1.55 |
| 1/29 - 2/4 | 35 | 30 - 41 | 445 | 1.33 |
| 2/5 - 2/11 | 36 | 30 - 40 | 786 | 1.66 |
| 2/12 - 2/18 | 36 | 30 - 41 | 414 | 1.77 |
| 2/19 - 2/25 | 36 | 29 - 50 | 1727 | 2.06 |
| 2/26 - 3/4 | 36 | 31 - 54 | 643 | 2.21 |
| 3/5 - 3/11 | 44 | 32 - 63 | 102 | 8.93 |
| 3/12 - 3/18 | 49 | 32 - 61 | 224 | 6.20 |
| 3/19 - 3/25 | 49 | 33 - 70 | 316 | 4.98 |
| 3/26 - 4/1 | 49 | 33 - 82 | 444 | 4.55 |
| 4/2 - 4/8 | 51 | 35 - 87 | 192 | 8.47 |
| 4/9 - 4/15 | 65 | 38 - 98 | 88 | 16.86 |
| 4/16 - 4/22 | 70 | 42 - 94 | 85 | 13.70 |
| 4/23 - 4/29 | 69 | 45 - 92 | 41 | 15.02 |
| 4/30 - 5/6 | 82 | 67 - 97 | 46 | 6.80 |
| 5/7 - 5/13 | 84 | 55 - 103 | 94 | 7.92 |
| 5/14 - 5/20 | 82 | 36 - 110 | 35 | 13.73 |
| 5/21 - 5/27 | 84 | 67 - 104 | 61 | 7.11 |
| 5/28 - 6/3 | 83 | 64 - 104 | 79 | 5.98 |
| 6/4 - 6/10 | 84 | 73 - 116 | 20 | 9.52 |
| 6/11 - 6/17 | 87 | 72 - 105 | 14 | 9.74 |
| 6/18 - 6/24 | - | - | - | - |
| 6/25 - 7/1 | - | - | - | - |

The subsample of fall-run that were measured for fork length were also assessed for life stage (Figure 15; Table 4). Most of these fish were identified as button-up fry and accounted for 64.1% (*n* = 3,020) of the assessed catch. The remaining life stage catch composition consisted of yolk-sac fry (0.7*%, n* = 34), parr (25.1*%, n* = 1,184), silvery parr (9.8*%, n* = 460) and smolts (0.3*%, n* = 16). Fall-run Chinook Salmon identified as yolk-sac fry were captured between January 24 and March 3. Button-up fry were captured between January 8 and May 17. Parr were captured between February 19 and May 17, and silvery parr were caught between March 22 and June 14. Lastly, smolts were captured between April 13 and June 12. Average weekly fork lengths increased with life stage progression with yolk-sac fry life stage having the lowest average weekly fork lengths, and smolts having the largest average weekly fork lengths. Fork lengths for the fall-run life stages averaged 34 mm for yolk-sac fry, 36 mm for button-up fry, 50 mm for parr, 82 mm for silvery parr, and 95 mm for smolts (Table 4).

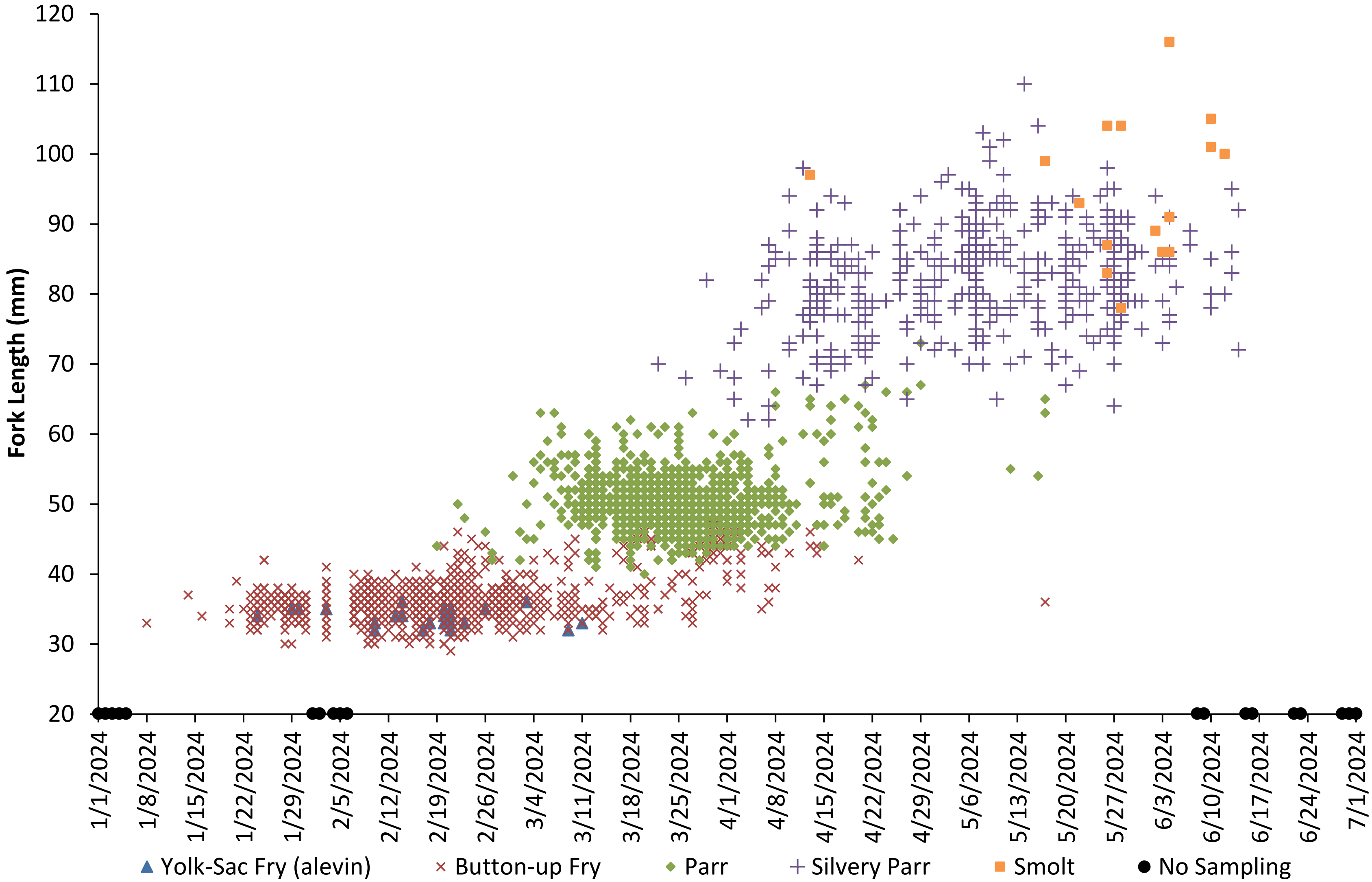


**Figure 15: Daily fork length distribution by life stage of natural origin fall-run Chinook Salmon measured during the 2024 Stanislaus River RST sampling season.**

**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 Stanislaus 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 | - | - | - | - | - |
| 1/8 - 1/14 | - | 35 (33 - 37, *n* = 2) | - | - | - |
| 1/15 - 1/21 | - | 35 (33 - 39, *n* = 4) | - | - | - |
| 1/22 - 1/28 | 34 (34, *n* = 1) | 35 (30 - 42, *n* = 214) | - | - | - |
| 1/29 - 2/4 | 35 (35, *n* = 4) | 35 (30 - 41, *n* = 390) | - | - | - |
| 2/5 - 2/11 | 33 (32 - 33, *n* = 2) | 36 (30 - 40, *n* = 508) | - | - | - |
| 2/12 - 2/18 | 34 (32 - 36, *n* = 7) | 36 (30 - 41, *n* = 407) | - | - | - |
| 2/19 - 2/25 | 34 (32 - 35, *n* = 15) | 36 (29 - 46, *n* = 882) | 47 (44 - 50, *n* = 3) | - | - |
| 2/26 - 3/4 | 35 (35 - 36, *n* = 3) | 36 (31 - 44, *n* = 448) | 47 (42 - 56, *n* = 11) | - | - |
| 3/5 - 3/11 | 33 (32 - 33, *n* = 2) | 37 (32 - 45, *n* = 49) | 53 (47 - 63, *n* = 52) | - | - |
| 3/12 - 3/18 | - | 36 (32 - 44, *n* = 30) | 51 (41 - 62, *n* = 219) | - | - |
| 3/19 - 3/25 | - | 39 (33 - 46, *n* = 24) | 50 (40 - 61, *n* = 330) | 70 (70, *n* = 1) | - |
| 3/26 - 4/1 | - | 41 (33 - 47, *n* = 41) | 49 (42 - 63, *n* = 360) | 73 (68 - 82, *n* = 3) | - |
| 4/2 - 4/8 | - | 41 (35 - 46, *n* = 14) | 50 (44 - 66, *n* = 130) | 75 (62 - 87, *n* = 18) | - |
| 4/9 - 4/15 | - | 44 (43 - 46, *n* = 5) | 51 (44 - 65, *n* = 32) | 80 (67 - 98, *n* = 42) | 97 (97, *n* = 1) |
| 4/16 - 4/22 | - | 42 (42, *n* = 1) | 55 (46 - 67, *n* = 30) | 79 (67 - 94, *n* = 56) | - |
| 4/23 - 4/29 | - | - | 56 (45 - 73, *n* = 13) | 81 (65 - 94, *n* = 28) | - |
| 4/30 - 5/6 | - | - | - | 84 (70 - 97, *n* = 47) | - |
| 5/7 - 5/13 | - | - | 55 (55, *n* = 1) | 84 (65 - 103, *n* = 80) | - |
| 5/14 - 5/20 | - | 36 (36, *n* = 1) | 61 (54 - 65, *n* = 3) | 84 (67 - 110, *n* = 47) | 99 (99, *n* = 1) |
| 5/21 - 5/27 | - | - | - | 83 (64 - 98, *n* = 83) | 92 (83 - 104, *n* = 4) |
| 5/28 - 6/3 | - | - | - | 82 (73 - 94, *n* = 33) | 89 (78 - 104, *n* = 4) |
| 6/4 - 6/10 | - | - | - | 83 (76 - 91, *n* = 14) | 100 (86 - 116, *n* = 5) |
| 6/11 - 6/17 | - | - | - | 84 (72 - 95, *n* = 8) | 100 (100, *n* = 1) |
| 6/18 - 6/24 | - | - | - | - | - |
| 6/25 - 7/01 | - | - | - | - | - |
| Total | 34 (32 - 36, *n* = 34) | 36 (29 - 47, *n* = 3,020) | 50 (40 - 73, *n* = 1,184) | 82 (62 - 110, *n* = 460) | 95 (78 - 116, *n* = 16) |

## Fulton's Condition Factor

Fulton's condition factor (K) values for natural origin fall-run Chinook Salmon captured in 2024 were variable across life stages (Figure 16). There were not any significant changes or trends in K. The mean K was 0.92 for button-up fry, 0.91 for parr, 1.07 for silvery parr, and 1.10 for smolt (Figure 17, Appendix 3). Yolk-sac fry captured in 2024 could not be assessed for Fulton's condition factor because all fall-run identified at this life stage measured less than 40 mm and were therefore not weighed.

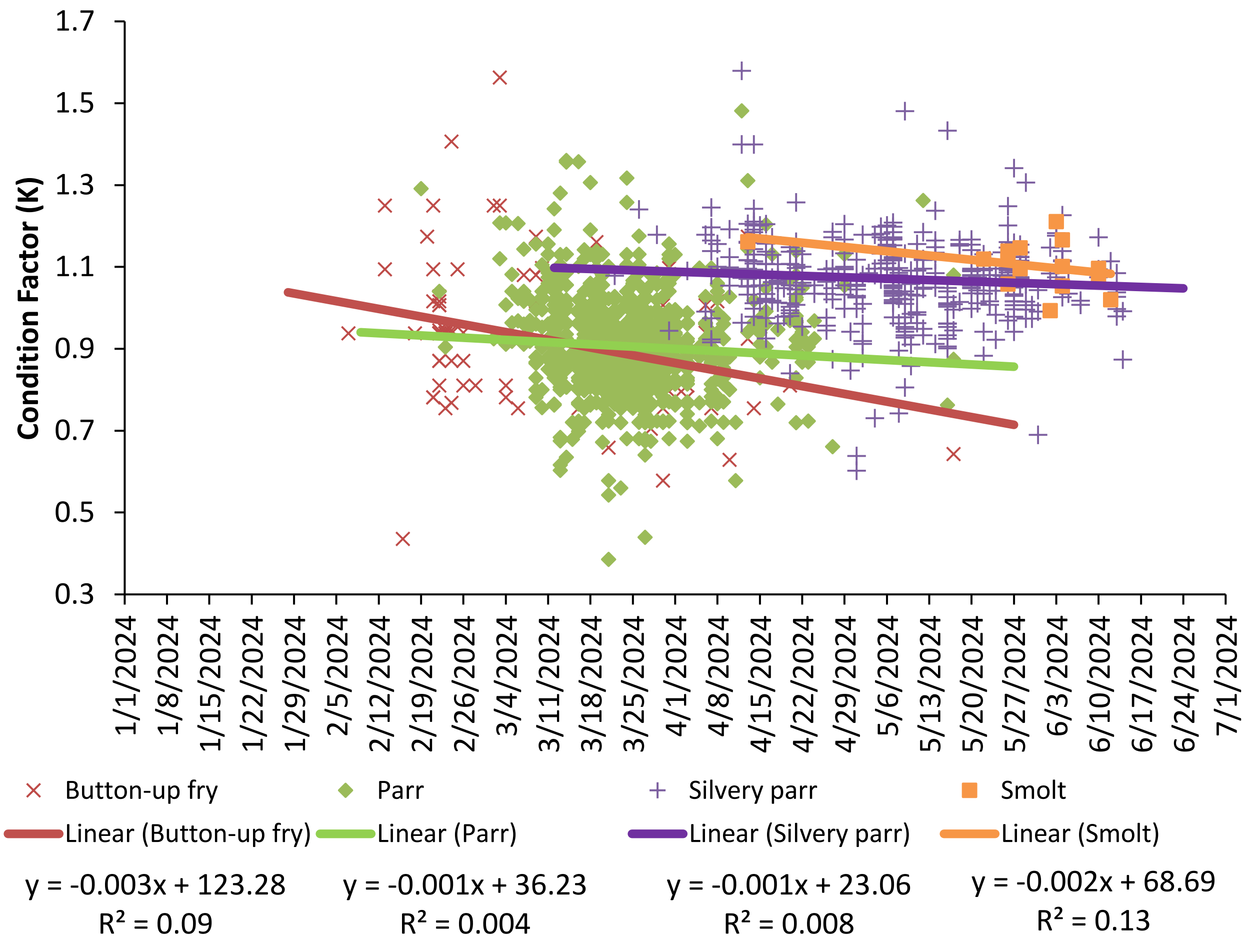


**Figure 16: Fulton's condition factor (K), by life-stage, of fall-run Chinook Salmon during the 2024 Stanislaus River RST sampling season.**

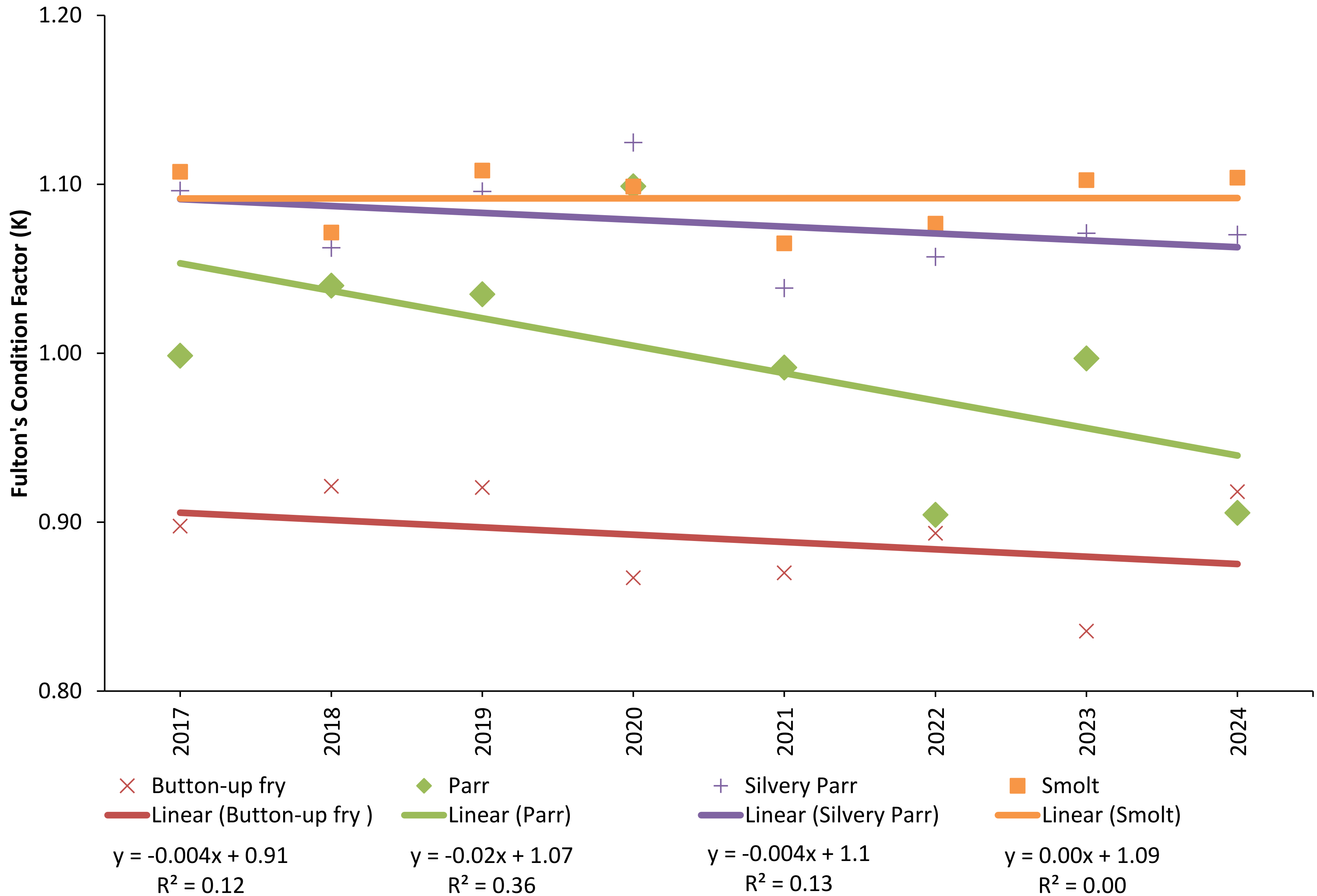


**Figure 17: Average Fulton's condition factor by life stage for natural origin fall-run Chinook Salmon from 2017 through 2024.**

## Trap Efficiency

Seven trap efficiency trials were conducted during the 2024 sampling season, all of which were determined to be included in analysis (Table 5). The seven trials used a total of 4,797 fall-run Chinook Salmon. Of these fish, 817 were natural origin salmon collected from the RSTs and marked with BBY. The remaining 3,980 were acquired from Merced River Hatchery and marked with VIE. The average trap efficiency for Trap 1 and Trap 2 for the entire sampling season were 0.50% and 1.29% respectively, with a total of 84 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 Stanislaus River RST sampling season.**

| Date Marked | Fish Origin | Mark Type | Trial Length (days) | Included in Analysis | Release Date | Release Time | Flow (cfs) | Release Avg FL (mm) | Number of Fish Released | Capture Efficiency | Recapture Avg FL (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/9/2024 | Natural | BBY | 14 | Yes | 2/10/2024 | 16:55 | 1,710 | 36 | 432 | 3.01% | 37 |
| 2/28/2024 | Natural | BBY | 14 | Yes | 2/29/2024 | 17:35 | 1,690 | 35 | 385 | 5.19% | 37 |
| 3/19/2024 | Hatchery | VIE | 14 | Yes | 3/20/2024 | 17:54 | 1,620 | 56 | 812 | 1.11% | 58 |
| 4/2/2024 | Hatchery | VIE | 14 | Yes | 4/3/2024 | 18:11 | 609 | 61 | 864 | 1.74% | 64 |
| 4/9/2024 | Hatchery | VIE | 14 | Yes | 4/10/2024 | 18:10 | 418 | 66 | 725 | 2.07% | 66 |
| 4/16/2024 | Hatchery | VIE | 14 | Yes | 4/17/2024 | 18:23 | 400 | 70 | 807 | 1.24% | 73 |
| 4/23/2024 | Hatchery | VIE | 14 | Yes | 4/24/2024 | 18:36 | 451 | 78 | 772 | 0.26% | 77 |

**Table 6: Trap efficiencies applied to calculate passage estimates for each trap location from 2017 through 2024.**

| Year | Water Year Type | Trap 1 | Trap 2 |
|---|---|---|---|
| 2017 | Wet | 0.78% | 1.53% |
| 2018 | Below Normal | 0.62% | 1.39% |
| 2019 | Wet | 0.35% | 0.39% |
| 2020 | Dry | 1.20% | 1.76% |
| 2021 | Critical | 3.33% | 6.47% |
| 2022 | Critical | 3.73% | 8.12% |
| 2023 | Wet | 1.02% | 1.06% |
| 2024 | Above Normal | 0.50% | 1.29% |

## 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 Mark-Spline Model estimates that 452,900 natural origin fall-run Chinook Salmon emigrated past the Caswell RSTs during the 2024 sampling season (95% CI 364,700 – 586,300; Appendix 4). Flat efficiency rates of 0.50% and 1.29% were applied to Trap 1 and Trap 2, respectively, as less than 10 trials were conducted during the 2024 sampling season (Table 6, Appendix 5). Fall-run passage estimates peaked on February 20 when 42,756 were estimated to have emigrated past the RSTs during a period of high turbidity (Figure 18). The cumulative fall-run passage exceeded 95% on May 1 (Figure 19). Consistent with previous years, most fall-run were estimated to have emigrated past the RSTs as fry (Figure 20).

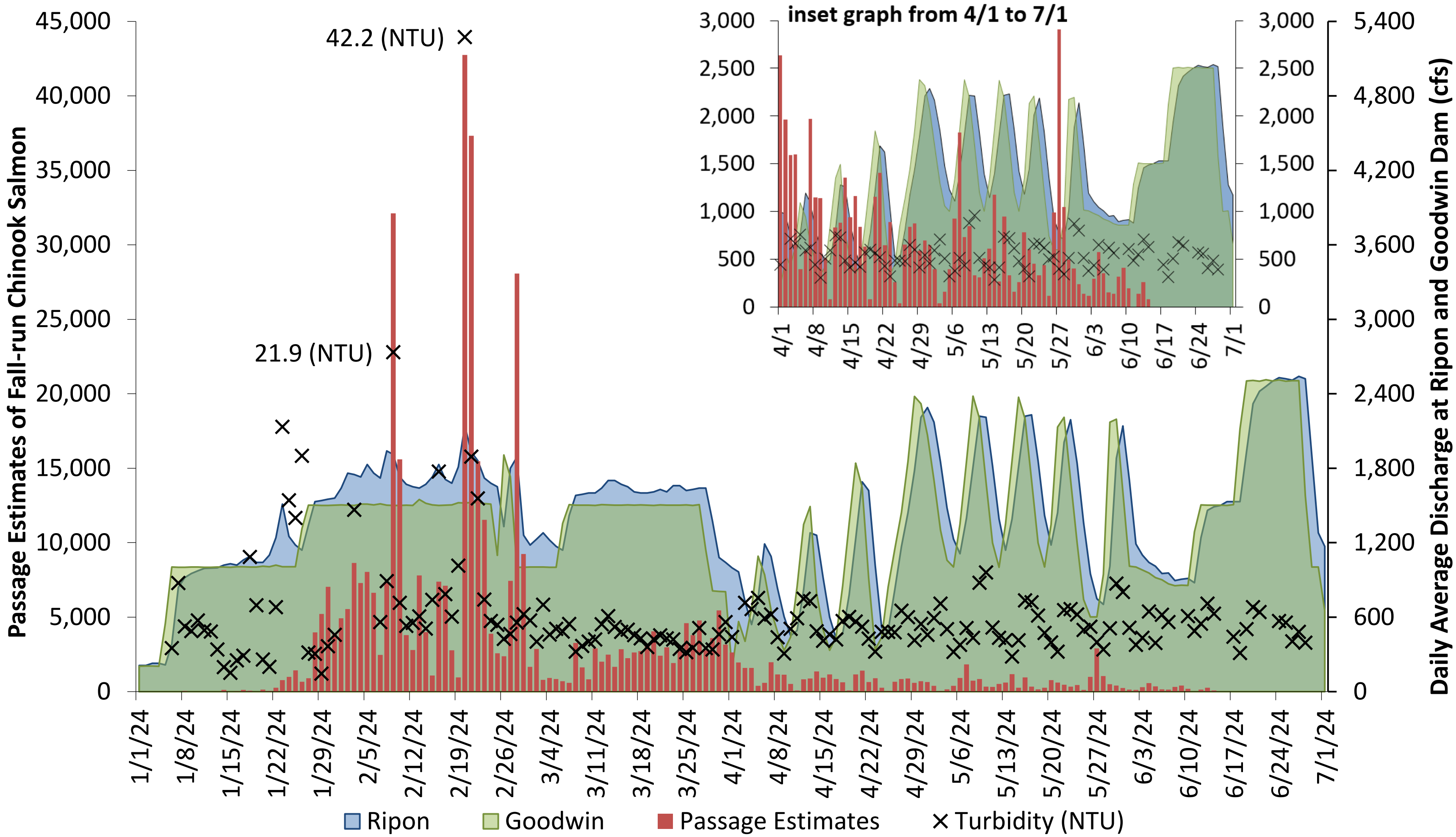


**Figure 18: Daily passage of natural origin fall-run Chinook Salmon calculated by the CAMP RST Mark-Spline Model with daily average turbidity measured at the RSTs (NTU), and discharge measured at Ripon and Goodwin Dam (cfs), during the 2024 Stanislaus River RST sampling season.**

**P***assage 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.*

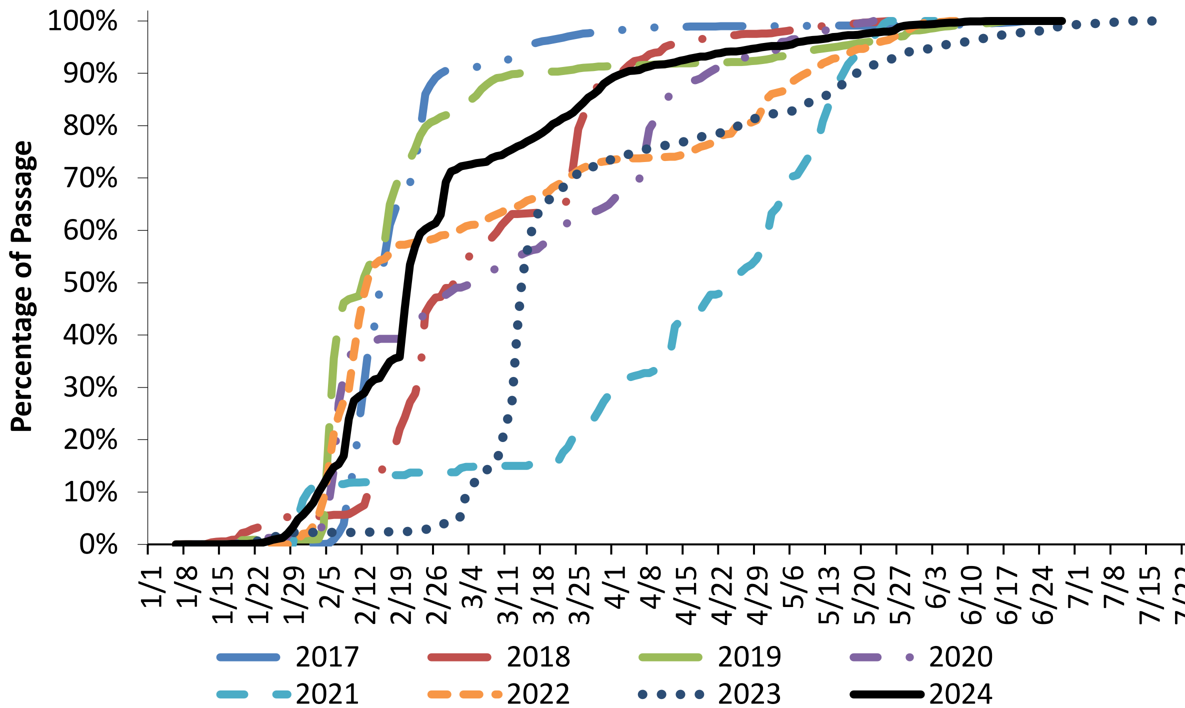


**Figure 19: Cumulative passage of natural origin fall-run Chinook Salmon calculated by the CAMP RST Mark-Spline Model at the Stanislaus River RSTs at Caswell Memorial State Park from 2017 through 2024 (all years that PSMFC has operated the Caswell RSTs).**
*Passage estimates in this figure were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.*

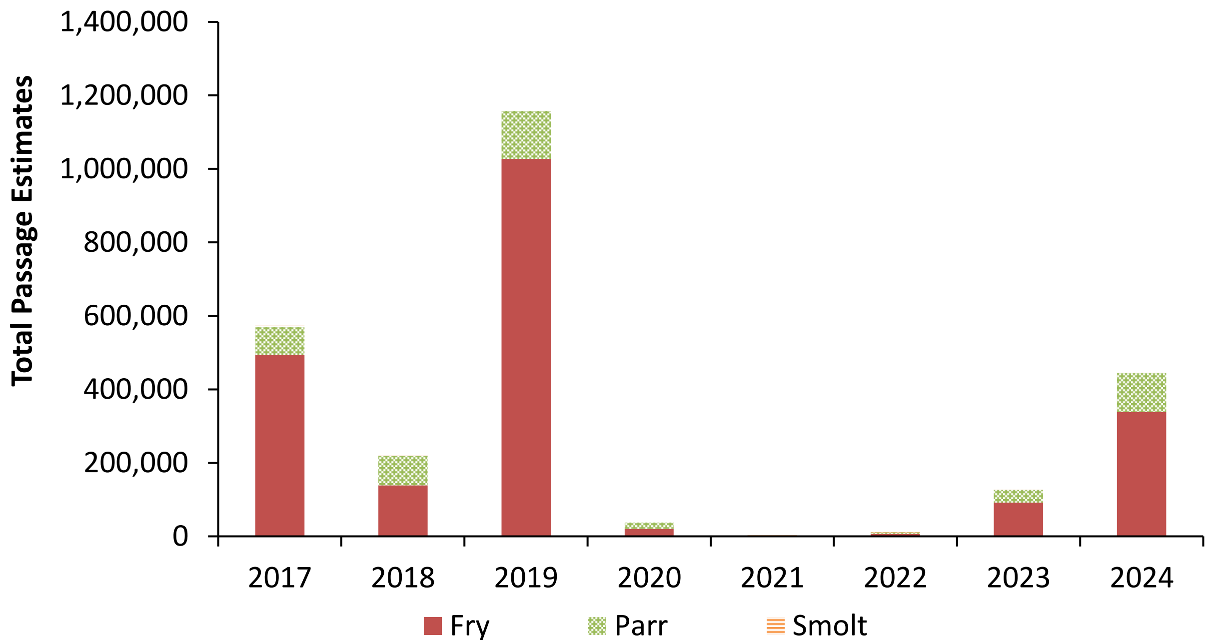


**Figure 20: Annual fall-run Chinook Salmon passage estimates by life stage calculated through the CAMP RST Mark-Spline Model for the Stanislaus River RSTs from 2017 through 2024.**
*Passage estimates in this figure were derived from the CAMP RST Platform Mark-Spline Model and are provisional. Once a more advanced model is developed, these numbers will change.*

## Genetic Analysis

A total of 133 genetic samples were taken from Chinook Salmon, comprising 58 LAD fall-run and 75 LAD spring-run, and analyzed using SNP genetic markers to determine final run assignments (Appendix 6). All Chinook Salmon that were sampled for genetics did not have a clipped adipose fin and were presumed to be of natural origin. The SNP panel's probabilities for 91% (*n* = 121) of the genetic samples exceeded the 50 percent threshold, allowing for run assignments based on the genetic analysis. The remaining 12 samples were classified as "No Call" due to unsuccessful DNA extraction, preventing genetic run assignment.

Throughout the 2024 sampling season, 6,002 natural origin Chinook Salmon were captured and classified as fall-run using the LAD criteria. Genetic samples were collected from 58 LAD fall-run throughout the 2024 sampling season. SNP genetic analysis markers indicated that 93% (*n* = 54) of these individuals were indeed fall-run (Table 7, Appendix 6). The remaining four fall-run that were genetically sampled were classified as "No Call". Given the high accuracy of the LAD criteria for this run, a final run assignment of fall was applied to the four "No Call" samples and to the remaining 5,944 LAD fall-run that were not genetically sampled (Figure 21).

Additionally, 77 natural origin Chinook Salmon were captured and classified as spring-run using the LAD criteria. Genetic samples were collected from 75 LAD spring-run throughout the 2024 sampling season. SNP analysis revealed that 89% (*n* = 67) were fall-run (Figure 21; Appendix 6). The remaining eight LAD spring-run that were genetically sampled were classified as "No Call". Due to the inaccuracy of the LAD criteria for this run, a final run assignment of fall-run was applied to the eight "No Call" samples and the remaining two LAD spring-run that were not genetically sampled.

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

| LAD Run Assignment | SNP Confirmed Fall-Run | SNP Confirmed Late Fall-Run | SNP Confirmed Spring-Run | No Call |
|---|---|---|---|---|
| LAD Fall | 53 | 0 | 0 | 4 |
| LAD Late Fall | 0 | 0 | 0 | 0 |
| LAD Spring | 68 | 0 | 0 | 8 |

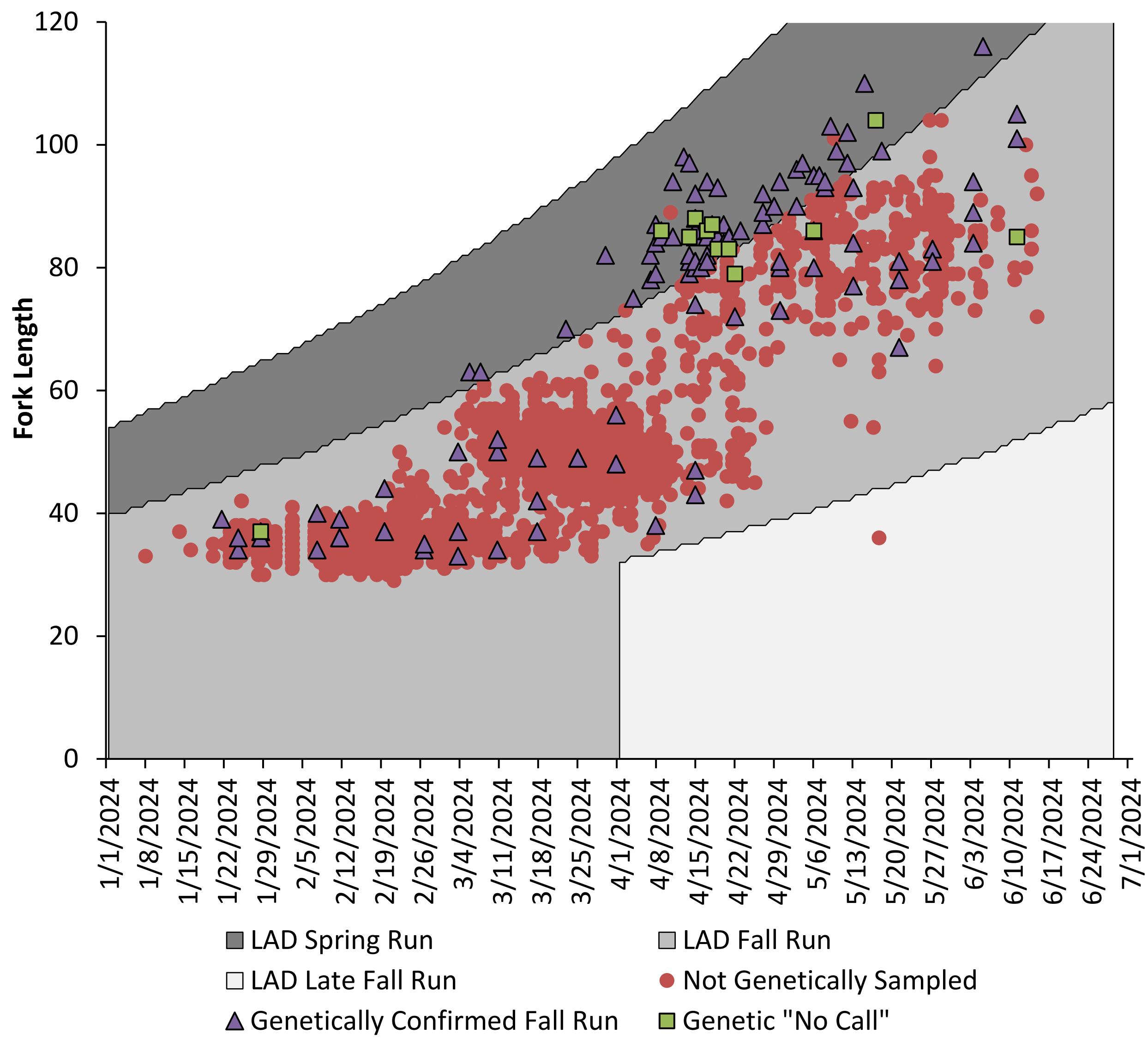


**Figure 21: Daily fork length distribution of SNP genetically and not genetically sampled natural origin Chinook Salmon measured during the 2024 Stanislaus River RST sampling season.**

### *O. mykiss*

One hatchery origin *O. mykiss* was captured on January 18. This fish had a fork length of 239 mm and was classified as a smolt.

### Non-salmonid Species

A total of 813 non-salmonid fish were captured during the 2024 sampling season. The majority (*n* = 782, 96%) of these fishes belonged to 29 identified species in the following families: Catostomidae (sucker), Centrarchidae (sunfish/black bass), Clupeidae (shad), Cottidae (sculpin), Cyprinidae (minnow), Embiotocidae (surfperch), Ictaluridae (bullhead/catfish), Moronidae (temperate bass), Osmeridae (smelt), Percidae (perch), Petromyzontidae (lamprey), and Poeciliidae (mosquitofish; Figure 22). The remaining 4% (*n* = 31) were not able to be identified to species level but belonged to the following families: Centrarchidae (*n* = 12), Cyprinidae (*n* = 2), Ictaluridae (*n* = 1), Petromyzontidae (*n* = 11), and unknown (*n* = 5). The majority of non-salmonid fish captured were not native to the Central Valley watershed (*n* =519, 64%) with the remaining individuals (*n* = 294, 36%) being native species. Fork lengths varied for non-salmonid catch throughout the 2024 sampling season (Appendix 7).

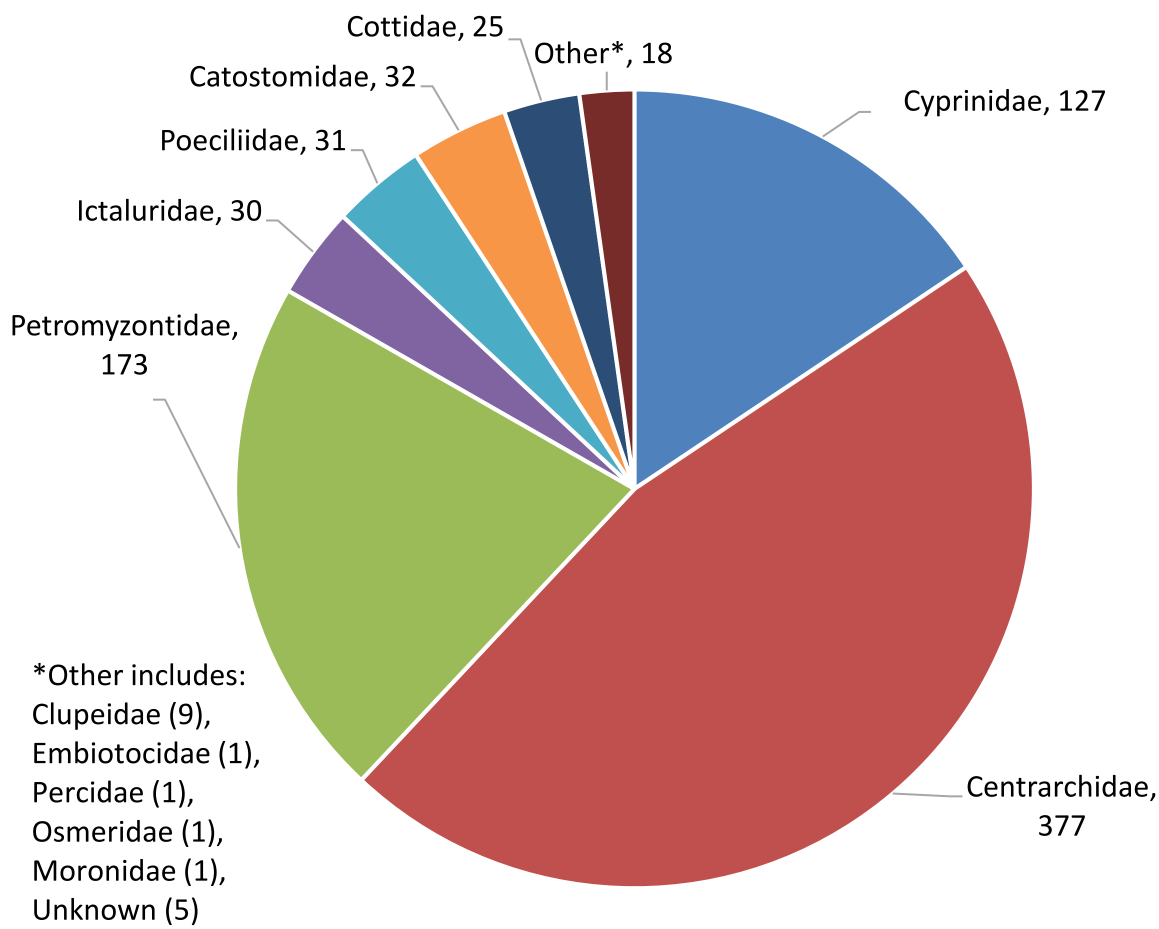


**Figure 22: Non-salmonid catch totals for each family of species collected during the 2024 Stanislaus River RST sampling season.**

Out of the 813 non-salmonid fish captured, 173 (21%) were identified as Petromyzontidae spp. (northern lampreys). Among these, 162 (94%) were identified as juvenile Pacific lamprey, while the remaining 11 (6%) were Petromyzontidae ammocoetes, which were unable to be identified to the species level. Catch of Pacific Lamprey peaked on January 18 when 21 (13%) of the total was captured (Figure 23). Catch of ammocoetes peaked on May 14 when 2 (18.2%) of the total was captured.

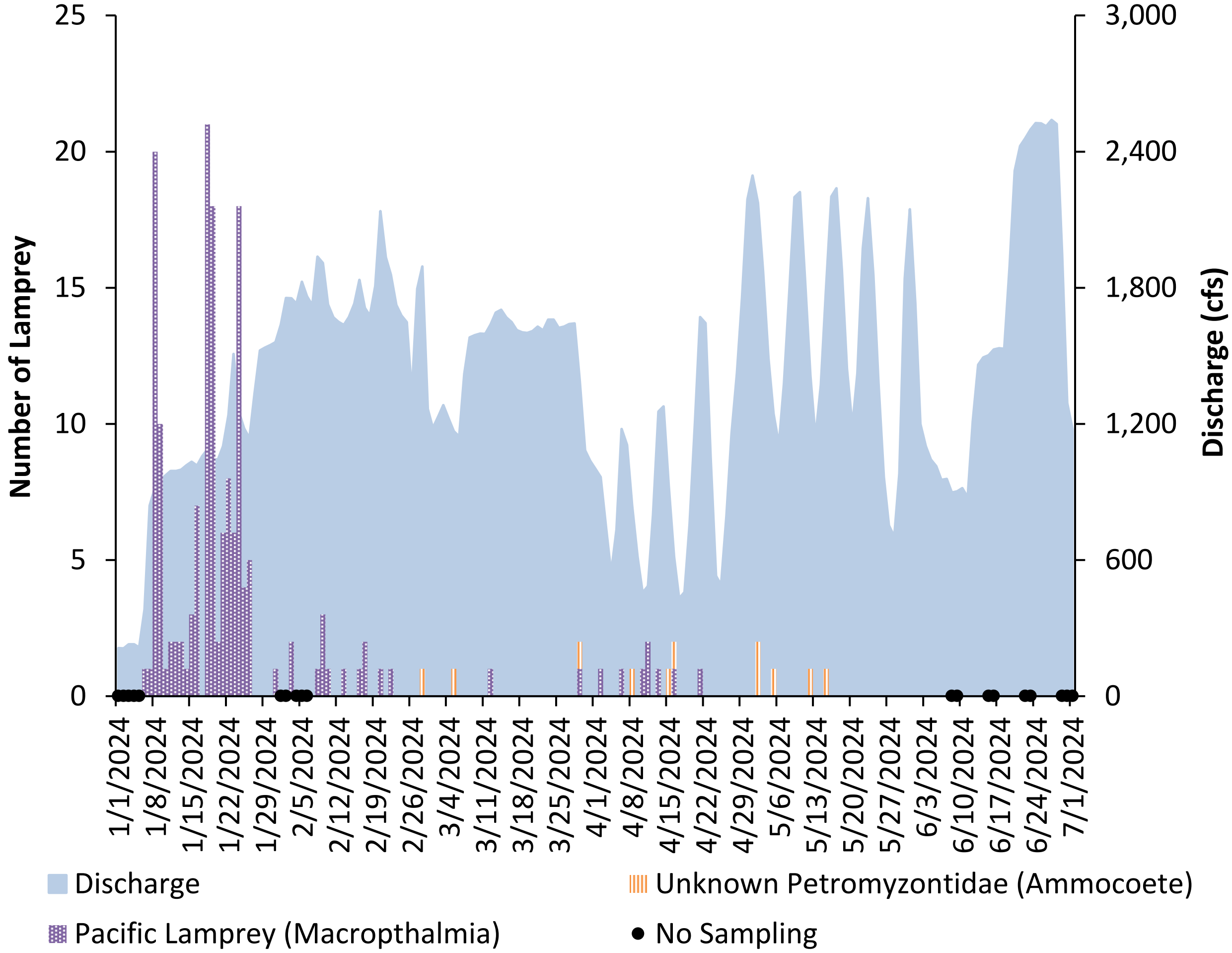


**Figure 23: Daily lamprey catch and daily average discharge (cfs) at Ripon during the 2024 Stanislaus River RST sampling season.**

# Discussion

## Project Scope

The continued operation of the Stanislaus River at Caswell Memorial State Park RSTs during the 2024 sampling season provided valuable biological monitoring data for emigrating juvenile salmonids. Primary objectives of the study were met by developing fall-run Chinook Salmon passage estimates and accurately quantifying catch of *O. mykiss*. 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 Stanislaus River salmonids by expanding on previous RST emigration surveys from CFS (CFS 2016) and PSMFC (PSMFC 2017 – 2023).

## Water Year Type

According to the California Department of Water Resource's San Joaquin Valley Water Year Hydrologic Classification Index, the 2024 water year classifies as "Above Normal" (CDWR 2024). Since the Stanislaus River contributes to this index, this classification can help relate data collected at the Caswell RSTs to previous sampling seasons.

During the 2024 sampling season, the USBR, with recommendations from the Stanislaus Watershed Team (SWT), committed to flow release schedules from Goodwin Dam in the winter (winter instability flows) and spring (spring pulse flows). These schedules were designed to mimic natural seasonal variations in streamflow through rapid increases and decreases in dam releases. Multiple studies have found that pulse flows can enhance the survival rates of juvenile salmonids by improving habitat and environmental conditions, as well as by triggering migration cues at optimal times (Michel et al. 2021, Zeug et al. 2014). Controlled release changes made at Goodwin Dam typically reach the Ripon USGS gauge within 36 hours. These flow changes are then estimated to be observed at Caswell approximately 6 to 8 hours after they are observed at Ripon, as the Caswell RST site is approximately 11.6 rkms downstream from Ripon.

## Catch and Passage Estimates

### Raw Catch

Several factors must be considered when interpreting the catch of fall-run Chinook Salmon and *O. mykiss* during the 2024 sampling season. The first significant factor is whether the sampling season encompassed the entirety of the juvenile salmonid emigration period. Through the first seven days of sampling during the 2024 season, 1 fall-run was captured, accounting for less than 0.1% of the total fall-run catch. Similarly, through the final seven days of sampling, no fall-run were captured by the RSTs. Due to the low catch that occurred the first and last seven days of sampling, it is likely that the sampling season encompassed both the beginning and end of the juvenile salmonid emigration period.

Trap operation is another critical factor to consider when interpreting annual catch in 2024. Ideally, the RSTs should operate continuously throughout the entire juvenile salmonid emigration period to accurately measure salmonid catch. During the sampling season, sampling occurred for 94% (164 days) of the 175-day season with a 90% successful sample rate (Figure 9,Figure 10, Figure 11). Heightened and variable flows, high winds, and precipitation events brought large and heavy debris downstream. This debris occasionally stopped the RSTs at the cone entrance or live well intakes, causing periods of unsuccessful operation. To mitigate the potential for trap stoppages on occasions when increased debris loads were observed, sampling crews conducted multiple trap checks per day to ensure the RSTs continuously operated. When debris loads were considered too high and unmanageable, the RSTs were taken out of service until conditions improved. Since fewer fish were likely captured during unsuccessful or suspended RST operation, the juvenile salmonid catch totals were likely biased low during these periods.

Following recommendations from previous sampling seasons (PSMFC 2023), a debris barrier was constructed and installed on January 17. The purpose of the debris barrier was to deflect large woody debris from entering and eventually stopping the RST cones from spinning. Prior to January 17 when the debris barrier was installed, the RSTs sampled successfully 71% of the time. After installing the debris barrier, the RSTs sampled successfully 92% of the time remaining in the sampling season. Although the debris barriers did not stop all debris from reaching and stopping the RST cones, the barrier ultimately contributed to a higher successful sampling percentage (90%) and more total successful hours (7,235) than had been accomplished in previous sampling seasons (PSMFC 2017 - 2023). The barrier also prevented some of the smaller floating debris on the surface from entering the trap livewell, which substantially sped up trap processing times and likely contributed to better in livewell conditions for fish health.

The *O. mykiss* smolt captured in 2024 was the first hatchery origin *O. mykiss* ever captured at Caswell since consistent sampling began in 1996. The hatchery of origin for this smolt is unknown. No natural origin *O.* mykiss were captured in 2024. Catch of natural origin *O. mykiss* has been historically minimal (annual range: 0 – 34) at the Caswell RST site since consistent sampling began in 1996 (CFS 2016, Appendix 4). Factors that likely contribute to the low annual catch of natural origin *O. mykiss* include larger salmonids having the swimming ability to avoid the RSTs, insufficient water velocity for optimal RST operation, and the heightened probability of unsuccessful sampling during discharge events when *O. mykiss* are expected to migrate (Eschenroeder et al. 2022, Johnson et al. 2007, USFWS 2008). Additionally, of the 185 *O. mykiss* captured since 1996, 169 (91%) had fork lengths greater than 150 mm. Eschenroeder et al. (2022) suggests that most *O. mykiss* in the Stanislaus River follow a resident life-history strategy and smolt emigration is less frequent.

## Efficiency Trials

Passage estimates are dependent on the quantity and quality of recapture efficiencies obtained through conducting trap efficiency trials. An attempt is made each sampling season to complete at least ten efficiency trials to ensure that there is high confidence in the passage estimates. However, insufficient catch of natural origin fall-run Chinook Salmon and only being allotted 5,000 fall-run Chinook Salmon from the Merced River Hatchery led to the completion of only seven efficiency trials in 2024 (Table 5).

Effective efficiency trials are also dependent upon adequate, stable flow and successful trap operation during the entirety of the efficiency trial period (USFWS 2008). However, several environmental factors had detrimental effects on the quality of the efficiency trials including insufficient velocities, flow alterations, and periods of unsuccessful sampling. Insufficient velocity can be one of the most challenging factors to control without making significant alterations to the RSTs or sampling site. The ideal velocity for 8-foot diameter RSTs is approximately 1.5 m/s (USFWS 2008). Velocities this high are rarely seen on the Stanislaus River at Caswell and were not observed in 2024 with velocity averaging 0.5 m/s with a range of 0.1 – 1.0 m/s.

In 2024, efficiency trials were conducted as frequently as possible when natural origin catch allowed. Trials were rarely conducted during stable flows because peaks in natural origin catch typically occurred during times when flows were highly variable or when turbidity was high. Overall, during the two trials in February that used smaller natural origin fish, trap efficiencies averaged 4.1% (range: 3.01 – 5.19%), while during the five trials in March and April that used larger hatchery origin fish averaged 1.3% (range: 0.26 – 2.07%). The decrease in capture efficiency between these trials could be explained by the increase in fork length, as seen in previous sampling seasons (PSMFC 2017 – 2023, Appendix 8).

Discharge could have also been a factor in differences in trap efficiency, however, it did not appear as significant as the higher fork lengths. Additionally, the traps did struggle with periods of unsuccessful sampling during periods of each 14-day trap efficiency trial, however, trap operations were successful the first day following release when most of the marked fall-run were recaptured ($n$ = 68, 81%). While it is likely that unsuccessful trap operations may have resulted in a few missed recaptures, potentially biasing the trap efficiencies low, the trap efficiencies were close to their expected values, therefore all trials were included for data analysis and fall-run passage estimation.

## 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 has been discontinued due to concerns about developing accuracy issues. An effort is currently underway to develop a new efficiency model that will incorporate various environmental covariates and historical efficiency trials, as the previous model intended. Meanwhile, the previous CAMP RST Platform Mark-Spline Model, which was used in 2017 and 2018 to calculate passage estimates, has been used again and re-ran for the 2019 to 2024 sampling seasons allowing for more meaningful annual comparisons (Appendix 4).

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 for the entire season (Table 6). Since 2017, this model has only used flat efficiency rates for calculating passage estimates for the Stanislaus River RSTs, as no season in that timeframe has had 10 or more efficiency trials. 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, etc.) and have inconsistent sampling, passage estimates calculated with this model can be highly problematic and misrepresentative. Specifically for the Caswell RSTs, the relationship between average release fork length and trap efficiency is highly correlated, so this model works best when the entire range of fork lengths is covered in trap efficiency trials (Appendix 8).

There are several concerns regarding the CAMP RST Mark-Spline Model used for calculating passage estimates for the 2024 sampling season. An exponential regression analysis of all efficiency trials conducted between 2017 and 2024 revealed that the average release fork length of release groups had the strongest correlation with trap efficiency (Appendix 8). As average fork lengths increased, trap efficiencies tend to decrease. Because a flat efficiency rate was applied to each trap, passage estimates for the fry life stage were likely overestimated, while those for parr and smolt life stages were likely underestimated (Figure 18 and Figure 20). Since most Chinook Salmon in 2024 migrated past the traps as fry, and efficiency trials yielded higher efficiencies with fry, the overall passage estimate in January, February, and March likely biased high. Conversely, as the sampling season progressed and life stages advanced to parr and smolt, efficiency trials with larger fish produced lower trap efficiencies. Due to the application of a flat and likely overestimated efficiency percent to these larger Chinook Salmon later in the season, the passage estimates for April, May, and June likely underestimate the number of Chinook Salmon in the parr and smolt life stages. However, despite potential discrepancies with using a flat efficiency to estimate passage in 2024, seven efficiency trials were conducted and showed consistent results with previous sampling seasons (PSMFC 2017 – 2023). 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.

A comparison of passage estimates from previous sampling seasons reveals a relationship between water year type and total passage. Since 2017, passage estimates have been larger in wet (2017, 2019, 2023), above normal (2024), and below normal water years (2018) when compared to dry (2020) and critical water years (2021, 2022; Appendix 4). Higher cumulative annual discharge in wet, above normal, and below normal water years provides a river habitat with more ideal environmental conditions for adult spawning and juvenile rearing. However, water year types at both ends of the spectrum place their own respective burdens on RST operations. Typically, wet, above normal, and below normal water years face issues associated with large debris floating downstream, which can stop the trap during periods when discharge is heightened (1,500 cfs and greater) and fall-run passage is likely high. Conversely, in dry and critical water year types, maintaining consistent trap operations during periods of low discharge (300 cfs and lower) is often challenging. Low discharge often does not provide optimal water velocities for reliable trap operation, likely underestimating passage during periods of low flow when passage is not expected to be high (PSMFC 2017 - PSMFC 2023).

## Biological Observations

Biological data were collected throughout the season to assist with the development of models that 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, most of the fall-run population emigrated as age-0 fry from the Stanislaus River (CFS 1996 and 2016, PSMFC 2017 – 2023). In the Central Valley, this emigration timing is most representative of an ocean-type life history, where recently emerged fry and parr leave their natal stream before summer to enter the ocean (Kjelson and Raquel 1981). The ocean-type life history strategy remained the primary life history strategy seen in 2024 with 70% ($n$ = 4,269) of the season’s fall-run catch being captured before March 5. During this period, fork lengths averaged 36 mm with 99% of the subsampled fish identified as yolk-sac fry or button-up fry.

After March 5, a steady increase in the ratio of parr, silvery parr, and smolt life stages were observed (Figure 15).

During the 2024 sampling season, three distinct peaks in catch of natural origin fall-run Chinook Salmon were observed. The first peak occurred on February 9 and 10, coinciding with increases in discharge and a period of high turbidity at Caswell (Appendix 9). Base flows at Goodwin Dam were measured at 1,500 cfs, however daily average flows of 1,940 cfs were realized at Ripon on February 9 due to rainfall runoff into the lower Stanislaus River below Goodwin Dam, which also significantly increased observed turbidity at Caswell. This peak accounted for 11% (n = 676) of the season's total catch within two days. The second and largest peak in catch, which spanned from February 20 to February 23, followed this trend and occurred during an increase in discharge and highest observed turbidity at Caswell during the 2024 sampling season (Appendix 9). Although base flows at Goodwin Dam were still at 1,500 cfs, daily average flows of 2,140 were recorded at Ripon on February 20 with average turbidity peaking at 42.2 NTUs (Appendix 9). Consequently, 26% (*n* = 1,596) of the season's fall-run Chinook Salmon were captured during this period. The last major peak in catch occurred on February 26. The USBR conducted a Winter Instability Flow out of Goodwin Dam at this time, increasing flows from 1,000 cfs to 2,500 cfs and then back down to 1,000 cfs over a 48-hour period. This change in discharge was realized at Ripon on February 28, coinciding with another pulse of fall-run Chinook Salmon between February 28 and 29, when 9% (*n* = 519) of the season's total was captured. Altogether, the three large peaks in catch in February accounted for 46% (*n* = 2,791) of the fall-run catch for the season. Smaller peaks in catch of later life stage juveniles were observed in April and May, likely due to the ongoing spring pulse flows during those months. These observations suggest that significant changes in discharge and resulting high turbidities were likely the most influential environmental factors in determining emigration timing of fall-run Chinook Salmon. Similar findings were reported by Zeug et al. (2014), who found that higher cumulative discharge and flow variability had the highest correlation with successful passage of juvenile Chinook Salmon on the Stanislaus River.

The Stanislaus River experienced discharges that remained slightly above the 15-year average during the 2024 sampling season (Appendix 10), resulting in lower than average in-river temperatures for most of the sampling season (Appendix 11). Daily average fork lengths of fall-run Chinook salmon captured at Caswell followed the 8-year average in January and February and dipped slightly below average in March (Appendix 12). The optimal growth temperature range for fall-run Chinook salmon is estimated to be between 15 and 19 °C (Myrick and Cech 2001). Periods of lower flow rates between the peaks of the spring pulse flows allowed ambient air temperature to have a greater influence on in-river temperatures, increasing in-river temperatures at times to daily averages between 15 and 19 °C. As in-river temperatures briefly exceeded 15 °C during the spring pulse flows in April and May, the daily average fork lengths of fall-run Chinook salmon exceeded the 8-year average in the subsequent days. However, sample sizes were often minimal later in the sampling season, likely skewing the daily average fork lengths during this time.

Since PSMFC began operating the Caswell RSTs in 2017, the yearly average condition factor (K) has remained relatively stable (Figure 17, Appendix 3). Contrarily, in 2024, the average K value for parr was lower than button-up fry for the first time since 2017. The decrease in average K for the parr life stage in 2024 can be explained by the average fork length of parr being 50 mm in 2024, compared to 60 mm in 2023. Typically, as juveniles develop into later life stages and rely entirely on external feeding, their condition factors generally increase, reflecting a more robust body shape. However, because the average fork length for the parr life stage was closer to the button-up fry life stage, condition factor was lower because of their low body-depth to fork length ratio. Annual changes in the condition factor on the Stanislaus River at Caswell may be a result of factors such as water temperatures, flow rates, and changes in habitat quality. However, further research is needed to determine the significance of each variable.

## 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 cold, variable water year types. However, we acknowledge several limitations and challenges when interpreting the data collected in 2024 and comparing to previous years due to limitations in sampling and differences in sampling methodologies.

Juvenile salmonid emigration monitoring will continue on the Stanislaus River at Caswell Memorial State Park in 2025. To obtain the highest accuracy for catch and passage estimation while maintaining the highest level of safety, adjustments are recommended for future seasons. Firstly, to achieve an increased level of accuracy in the passage estimates, additional focus should be applied to the quantity and quality of efficiency trials completed throughout the sampling season. Hatchery origin trial fish from the Merced River Hatchery or Mokelumne River Hatchery have been pre-approved by CDFW, which would allow for hatchery origin mark recapture trials between January and May if sufficient natural origin fish are not available. Secondly, the use of a debris barrier successfully reduced the quantity of debris that entered the RSTs and minimized trap stoppages in 2024, allowing for higher accuracy in catch and passage estimation. We recommend continuing the use of the debris barrier and continuing to improve its design for future sampling seasons. We believe these efforts will strengthen the future of the Stanislaus River Caswell RST project and continue to improve our understanding of juvenile salmonids while maintaining focus on safe sampling practices for our staff and the public.

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**Appendix 1:** **Weekly environmental conditions on the Stanislaus River during the 2024 sampling season.**

| Julian Week | Water Temperature (C°) Avg (Min - Max) | Discharge (cfs) Avg (Min - Max) | DO (mg/L) Avg (Min - Max) | Turbidity (NTU) Avg (Min - Max) | Velocity (m/s) Avg (Min - Max) |
|---|---|---|---|---|---|
| 1/1 - 1/7 | 9.9 (8.7 - 12.2) | 331 (210 - 840) | 10.55 (10.35 - 10.90) | 4.90 (2.28 - 8.61) | 0.5 (0.3 - 0.7) |
| 1/8 - 1/14 | 9.1 (8.4 - 9.9) | 978 (919 - 1,018) | 10.74 (10.34 - 11.49) | 3.55 (1.48 - 5.71) | 0.6 (0.4 - 0.9) |
| 1/15 - 1/21 | 10.4 (9.7 - 11.5) | 1,055 (1,016 - 1,101) | 10.84 (10.10 - 11.89) | 3.35 (1.16 - 8.97) | 0.5 (0.3 - 0.8) |
| 1/22 - 1/28 | 11.1 (10.4 - 11.7) | 1,310 (1,137 - 1,524) | 10.14 (9.29 - 10.78) | 9.46 (2.38 - 17.88) | 0.5 (0.3 - 0.9) |
| 1/29 - 2/4 | 10.7 (10.3 - 11.3) | 1,646 (1,537 - 1,754) | 10.13 (9.71 - 10.84) | 4.87 (0.64 - 11.87) | 0.5 (0.2 - 1.0) |
| 2/5 - 2/11 | 10.3 (9.7 - 10.9) | 1,793 (1,669 - 1,936) | 10.00 (9.06 - 10.54) | 8.69 (4.12 - 22.45) | 0.5 (0.2 - 0.8) |
| 2/12 - 2/18 | 10.6 (9.8 - 11.5) | 1,701 (1,636 - 1,835) | 9.89 (9.48 - 10.57) | 6.37 (3.63 - 15.31) | 0.5 (0.1 - 0.8) |
| 2/19 - 2/25 | 11.3 (10.6 - 11.9) | 1,827 (1,648 - 2,137) | 9.43 (8.79 - 10.14) | 13.24 (4.27 - 43.30) | 0.6 (0.3 - 1.0) |
| 2/26 - 3/4 | 11.3 (10.6 - 12.0) | 1,426 (1,182 - 1,893) | 9.74 (9.28 - 10.11) | 4.28 (2.53 - 5.72) | 0.5 (0.3 - 0.8) |
| 3/5 - 3/11 | 11.3 (10.5 - 12.0) | 1,389 (1,143 - 1,597) | 9.89 (9.47 - 10.12) | 3.53 (1.86 - 4.65) | 0.5 (0.3 - 0.8) |
| 3/12 - 3/18 | 11.8 (11.0 - 12.6) | 1,651 (1,596 - 1,703) | 9.79 (9.43 - 10.21) | 4.03 (3.15 - 5.07) | 0.6 (0.2 - 1.0) |
| 3/19 - 3/25 | 12.3 (11.6 - 13.0) | 1,625 (1,600 - 1,660) | 9.88 (9.62 - 10.10) | 3.27 (2.57 - 3.96) | 0.5 (0.2 - 0.8) |
| 3/26 - 4/1 | 11.8 (11.0 - 13.3) | 1,435 (1,038 - 1,643) | 9.98 (9.53 - 10.55) | 3.31 (2.28 - 4.57) | 0.3 (0.1 - 0.5) |
| 4/2 - 4/8 | 12.9 (10.4 - 15.2) | 896 (540 - 1,178) | 10.06 (8.85 - 11.22) | 5.05 (3.28 - 6.11) | 0.4 (0.3 - 0.6) |
| 4/9 - 4/15 | 14.2 (10.8 - 17.9) | 818 (456 - 1,276) | 9.66 (8.50 - 11.05) | 4.35 (2.40 - 6.66) | 0.4 (0.1 - 0.6) |
| 4/16 - 4/22 | 14.8 (11.4 - 18.5) | 867 (431 - 1,671) | 9.60 (8.38 - 11.03) | 4.06 (3.10 - 5.15) | 0.4 (0.2 - 0.5) |
| 4/23 - 4/29 | 14.6 (12.8 - 17.2) | 1,013 (490 - 1,644) | 9.68 (8.56 - 10.52) | 3.93 (2.45 - 5.86) | 0.4 (0.2 - 0.7) |
| 4/30 - 5/6 | 13.2 (11.3 - 14.6) | 1,860 (1,244 - 2,295) | 10.38 (10.00 - 11.06) | 4.05 (1.71 - 5.96) | 0.4 (0.2 - 0.6) |
| 5/7 - 5/13 | 13.6 (12.2 - 15.9) | 1,706 (1,107 -2,221) | 10.56 (10.02 - 10.79) | 4.69 (2.70 - 7.86) | 0.3 (0.2 - 0.5) |
| 5/14 - 5/20 | 14.7 (13.6 - 16.2) | 1,722 (1,138 - 2,238) | 9.81 (9.36 - 10.24) | 4.18 (2.20 - 6.27) | 0.4 (0.2 - 0.6) |
| 5/21 - 5/27 | 14.7 (13.5 - 16.5) | 1,569 (966 - 2,195) | 9.73 (9.37 - 10.18) | 4.21 (2.55 - 5.59) | 0.4 (0.2 - 0.6) |
| 5/28 - 6/3 | 16.0 (13.8 - 18.4) | 1,336 (702 - 2,146) | 9.40 (8.60 - 10.10) | 4.36 (2.38 - 6.97) | 0.4 (0.2 - 0.6) |
| 6/4 - 6/10 | 17.0 (15.1 - 18.5) | 981 (896 - 1,101) | 9.13 (8.51 - 9.63) | 4.24 (2.92 - 5.49) | 0.4 (0.2 - 0.6) |
| 6/11 - 6/17 | 16.3 (14.6 - 18.6) | 1,284 (876 - 1,527) | 9.34 (8.76 - 9.85) | 4.77 (3.49 - 6.13) | 0.4 (0.2 - 0.7) |
| 6/18 - 6/24 | 15.0 (13.9 - 16.0) | 2,093 (1,530 - 2,497) | 9.79 (9.51 - 10.29) | 4.12 (2.19 - 5.86) | 0.5 (0.3 - 0.7) |
| 6/25 - 7/1 | 15.3 (14.3 - 17.4) | 2,266 (1,292 - 2,539) | 9.82 (9.55 - 10.01) | 3.85 (2.79 - 4.60) | 0.4 (0.2 - 0.7) |

**Appendix 2:** **List of fish species caught during the 2024 Stanislaus River RST sampling season.**

| Common Name | Family Name | Species Name | Total |
|---|---|---|---|
| Chinook Salmon | Salmonidae | *Oncorhynchus tshawytscha* | 6,080 |
| Bigscale Logperch | Percidae | *Percina macrolepida* | 1 |
| Black Crappie | Centrarchidae | *Pomoxis nigromaculatus* | 7 |
| Bluegill | Centrarchidae | *Lepomis macrochirus* | 77 |
| Brown Bullhead | Ictaluridae | *Ameiurus nebulosus* | 1 |
| Channel Catfish | Ictaluridae | *Ictalurus punctatus* | 1 |
| Common Carp | Cyprinidae | *Cyprinus carpio* | 27 |
| Golden Shiner | Cyprinidae | *Notemigonus crysoleucas* | 34 |
| Green Sunfish | Centrarchidae | *Lepomis cyanellus* | 1 |
| Hardhead | Cyprinidae | *Mylopharodon conocephalus* | 5 |
| Hitch | Cyprinidae | *Lavinia exilicauda* | 5 |
| Largemouth Bass | Centrarchidae | *Micropterus salmoides* | 22 |
| Pacific Lamprey | Petromyzontidae | *Lampetra entosphenus* | 162 |
| Prickly Sculpin | Cottidae | *Cottus asper* | 19 |
| Red Shiner | Cyprinidae | *Cyprinella lutrensis* | 1 |
| Redear Sunfish | Centrarchidae | *Lepomis microlophus* | 10 |
| Riffle Sculpin | Cottidae | *Cottus gulosus* | 6 |
| Sacramento Pikeminnow | Cyprinidae | *Ptychocheilus grandis* | 21 |
| Sacramento Sucker | Catostomidae | *Catostomus occidentalis* | 32 |
| Smallmouth Bass | Centrarchidae | *Micropterus dolomieu* | 11 |
| Sacramento Splittail | Cyprinidae | *Pogonichthys macrolepidotus* | 32 |
| Spotted Bass | Centrarchidae | *Micropterus punctulatus* | 227 |
| Striped Bass | Moronidae | *Morone saxatilis* | 1 |
| Threadfin Shad | Clupeidae | *Dorosoma petenense* | 9 |
| Tule Perch | Embiotocidae | *Hysterocarpus traskii* | 1 |
| Unknown | Unknown | | 5 |
| Unknown Bass | Centrarchidae | *Micropterus sp.* | 3 |
| Unknown Catfish or Bullhead | Ictaluridae | | 1 |
| Unknown Centrarchid | Centrarchidae | | 4 |
| Unknown Lamprey | Petromyzontidae | | 11 |
| Unknown Minnow | Cyprinidae | | 2 |
| Unknown Sunfish | Centrarchidae | *Lepomis sp.* | 5 |
| Wakasagi / Japanese Smelt | Osmeridae | *Hypomesus nipponensis* | 1 |
| Warmouth | Centrarchidae | *Lepomis gulosus* | 2 |
| Western Mosquitofish | Poeciliidae | *Gambusia affinis* | 31 |
| White Catfish | Ictaluridae | *Ameiurus catus* | 27 |
| White Crappie | Centrarchidae | *Pomoxis annularis* | 8 |

**Appendix 3:** **Average Fulton's condition factor (Avg) and minimum and maximum condition factor (Range) by life stage for natural origin fall-run Chinook Salmon capture in the Stanislaus River at Caswell Memorial State Park RSTs from 2017 through 2024.**

| Year | Water Year Type | Button-up fry Avg (Range) | Parr Avg (Range) | Silvery parr Avg (Range) | Smolt Avg (Range) |
|---|---|---|---|---|---|
| 2017 | Wet | 0.90 (0.44 - 1.31) | 1.00 (0.53 - 2.35) | 1.10 (0.64 - 1.81) | 1.11 (0.84 - 1.28) |
| 2018 | Below Normal | 0.92 (0.38 - 1.21) | 1.04 (0.51 - 1.62) | 1.06 (0.80 - 1.69) | 1.07 (1.01 - 1.12) |
| 2019 | Wet | 0.92 (0.47 - 1.44) | 1.04 (0.74 - 1.79) | 1.10 (0.82 - 1.34) | 1.11 (1.01 - 1.18) |
| 2020 | Dry | 0.87 (0.87) | 1.10 (0.48 - 2.72) | 1.12 (0.56 - 1.93) | 1.10 (0.99 - 1.19) |
| 2021 | Critical | - | 0.99 (0.83 - 1.21) | 1.04 (0.68 - 1.26) | 1.07 (0.77 - 1.39) |
| 2022 | Critical | 0.89 (0.63 - 1.13) | 0.90 (0.67 - 1.16) | 1.06 (0.76 - 1.35) | 1.08 (1.00 - 1.22) |
| 2023 | Wet | 0.84 (0.47 - 1.13) | 1.00 (0.62 - 1.68) | 1.07 (0.86 - 1.54) | 1.10 (0.94 - 1.21) |
| 2024 | Above Normal | 0.92 (0.44 - 1.56) | 0.91 (0.39 - 1.48) | 1.07 (0.60 - 1.58) | 1.10 (0.99 - 1.21) |

**Appendix 4: Median discharge (cfs) between January 1 and July 30, San Joaquin Valley water year hydrologic classification, total catch of fall-run and spring-run Chinook Salmon, *O. mykiss*, total lamprey catch, and fall-run passage estimates with 95% confidence intervals calculated through the CAMP RST Mark-Spline Model from the 1996 – 2024 Stanislaus River RST sampling seasons (CFS 2016, PSMFC 2017-2023).**

| Year | Discharge (cfs) | Water Year Type | Fall-run Catch | Spring-run Catch | *O. mykiss* Catch | Lamprey Catch | Fall-run Passage Estimate | 95% CI |
|---|---|---|---|---|---|---|---|---|
| 1996 | 1,190 | Wet | 2,468 | 0 | 4 | 857 | - | - |
| 1997 | 1,670 | Wet | 2,357 | 0 | 11 | 57 | - | - |
| 1998 | 2,030 | Wet | 19,525 | 0 | 4 | 445 | 1,180,722 | (1,033,837 - 1,322,639) |
| 1999 | 1,510 | Above Normal | 41,234 | 0 | 12 | 969 | 1,569,638 | (1,407,537 - 1,733,527) |
| 2000 | 1,000 | Above Normal | 73,715 | 0 | 15 | 4,356 | 2,269,547 | (1,998,132 - 2,601,198) |
| 2001 | 530 | Dry | 9,907 | 0 | 34 | 9,762 | 94,214 | (88,684 - 101,224) |
| 2002 | 534 | Dry | 3,835 | 0 | 10 | 210 | 50,819 | (46,240 - 55,695) |
| 2003 | 587 | Below Normal | 14,059 | 0 | 13 | 476 | 100,457 | (89,196 - 110,637) |
| 2004 | 470 | Dry | 40,087 | 0 | 19 | 3,589 | 527,624 | (412,083 - 661,730) |
| 2005 | 348 | Wet | 25,287 | 0 | 11 | 5,551 | 247,204 | (219,565 - 275,951) |
| 2006 | 2,980 | Wet | 1,589 | 0 | 2 | 9 | 327,502 | (215,478 - 522,869) |
| 2007 | 858 | Critical | 2,909 | 0 | 23 | 502 | 97,218 | (51,909 - 175,480) |
| 2008 | 462 | Critical | 230 | 0 | 1 | 1,010 | 30,829 | (22,334 - 41,264) |
| 2009 | 376 | Dry | 767 | 0 | 5 | 1,074 | 4,964 | (3,552 - 6,965) |
| 2010 | 345 | Above Normal | 1,102 | 0 | 1 | 5,011 | 17,734 | (10,762 - 26,081) |
| 2011 | 1,670 | Wet | 605 | 0 | 2 | 545 | 44,677 | (27,500 - 78,116) |
| 2012 | 601 | Dry | 1,199 | 0 | 3 | 265 | 18,950 | (10,270 - 30,648) |
| 2013 | 451 | Critical | 19,072 | 0 | 4 | 276 | 370,431 | (308,067 - 429,705) |
| 2014 | 347 | Critical | 2,083 | 0 | 3 | 1,304 | 22,209 | (18,865 - 26,688) |
| 2015 | 245 | Critical | 905 | 0 | 2 | 1,162 | 9,577 | (8,567 - 10,444) |
| 2016 | 299 | Dry | 2,207 | 0 | 2 | 11,839 | 26,220 | (24,117 - 28,367) |
| 2017 | 1,530 | Wet | 8,246 | 0 | 0 | 5 | 573,604 | (475,507 - 702,206) |
| 2018 | 984 | Below Normal | 3,515 | 1 | 0 | 272 | 218,995 | (165,510 - 271,3) |
| 2019 | 1,990 | Wet | 6,498 | 0 | 0 | 686 | 1,122,000 | (742,700 - 1,833,000) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2020 | 809 | Dry | 912 | 0 | 2 | 1,624 | 38,530 | (29,120 - 50,030) |
| 2021 | 554 | Critical | 199 | 0 | 0 | 3,444 | 2,929 | (2,244 - 3,757) |
| 2022 | 472 | Critical | 989 | 0 | 0 | 253 | 10,990 | (9,744 - 13,500) |
| 2023 | 1,500 | Wet | 2,293 | 0 | 2 | 175 | 131,100 | (102,800 - 165,200) |
| 2024 | 1,520 | Above Normal | 6,080 | 0 | 1 | 173 | 452,900 | (364,700 - 586,300) |

*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 5:** **Daily fall-run Chinook Salmon passage estimates calculated with the CAMP RST Mark Spline model and days no production estimates could be calculated (No PE) for the Caswell RSTs from 2017 through 2024.**

| Date | 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 |
| 1/2 | 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 |
| 1/4 | 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 |
| 1/6 | No PE | No PE | No PE | No PE | No PE | 0 | No PE | 0 |
| 1/7 | No PE | No PE | No PE | 0 | No PE | 0 | No PE | 0 |
| 1/8 | No PE | No PE | No PE | 0 | No PE | 0 | No PE | 39 |
| 1/9 | No PE | No PE | No PE | 0 | No PE | 0 | No PE | 0 |
| 1/10 | No PE | No PE | No PE | 0 | No PE | 0 | No PE | 0 |
| 1/11 | No PE | No PE | 0 | 0 | No PE | 0 | No PE | 0 |
| 1/12 | No PE | 198 | 0 | 0 | No PE | 0 | No PE | 0 |
| 1/13 | No PE | 665 | 0 | 0 | No PE | 0 | No PE | 0 |
| 1/14 | No PE | 306 | 0 | 0 | 0 | 0 | No PE | 123 |
| 1/15 | No PE | 109 | 0 | 28 | 0 | 0 | No PE | 0 |
| 1/16 | No PE | 0 | 0 | 0 | 0 | 0 | No PE | 20 |
| 1/17 | No PE | 629 | 0 | 0 | 0 | 0 | No PE | 125 |
| 1/18 | No PE | 153 | 283 | 57 | 0 | 0 | No PE | 60 |
| 1/19 | No PE | 2715 | 9067 | 125 | 0 | 0 | No PE | 0 |
| 1/20 | No PE | 558 | 0 | 111 | 0 | 0 | No PE | 139 |
| 1/21 | No PE | 1077 | 283 | 42 | 0 | 0 | No PE | 39 |
| 1/22 | No PE | 665 | 283 | 83 | 0 | 0 | 816 | 270 |
| 1/23 | No PE | 703 | 283 | 0 | 0 | 0 | 536 | 772 |
| 1/24 | No PE | 612 | 0 | 42 | 0 | 0 | 205 | 987 |
| 1/25 | No PE | 1763 | 0 | 0 | 0 | 0 | 191 | 1434 |
| 1/26 | No PE | 998 | 0 | 0 | 0 | 0 | 380 | 655 |
| 1/27 | No PE | 297 | 0 | 0 | 0 | 0 | 431 | 893 |
| 1/28 | No PE | 117 | 0 | 0 | 0 | 0 | 292 | 3973 |
| 1/29 | No PE | 72 | 0 | 0 | 0 | 6 | 146 | 5217 |
| 1/30 | No PE | 0 | 0 | 249 | 152 | 92 | 0 | 7042 |
| 1/31 | No PE | 0 | 0 | 42 | 98 | 124 | 0 | 3908 |
| 2/1 | No PE | 36 | 0 | 83 | 47 | 13 | 0 | 4930 |
| 2/2 | 64 | 0 | 0 | 0 | 27 | 150 | 0 | 5536 |
| 2/3 | 162 | 180 | 836 | 159 | 0 | 209 | 0 | 8648 |
| 2/4 | 193 | 306 | 25259 | 391 | 0 | 365 | 0 | 7283 |
| 2/5 | 579 | 108 | 195642 | 1593 | 0 | 655 | 0 | 8030 |
| 2/6 | 4503 | 242 | 167011 | 2506 | 8 | 713 | 0 | 6632 |
| 2/7 | 6919 | 0 | 76687 | 4866 | 6 | 380 | 0 | 2467 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2/8 | 10750 | 36 | 42425 | 1945 | 0 | 307 | 0 | 7375 |
| 2/9 | 40094 | 234 | 7692 | 1441 | 6 | 246 | 0 | 32122 |
| 2/10 | 22999 | 1181 | 3315 | 545 | 3 | 769 | 0 | 15600 |
| 2/11 | 51574 | 1433 | 3471 | 329 | 0 | 696 | 49 | 3789 |
| 2/12 | 46057 | 1270 | 40555 | 0 | 2 | 546 | 49 | 2789 |
| 2/13 | 47091 | 7080 | 25846 | 229 | 0 | 407 | 0 | 7796 |
| 2/14 | 17778 | 3012 | 4052 | 98 | 0 | 189 | 0 | 3989 |
| 2/15 | 40567 | 2169 | 15830 | 170 | 23 | 94 | 0 | 1087 |
| 2/16 | 38846 | 5604 | 28988 | 0 | 0 | 32 | 49 | 7387 |
| 2/17 | 35447 | 2490 | 80637 | 0 | 0 | 114 | 0 | 7103 |
| 2/18 | 16642 | 4263 | 33278 | 0 | 15 | 142 | 0 | 2773 |
| 2/19 | 16403 | 7607 | 28248 | 0 | 0 | 40 | 47 | 948 |
| 2/20 | 1356 | 5010 | 21406 | 0 | 0 | 0 | 49 | 42756 |
| 2/21 | 12938 | 6411 | 12920 | 439 | 15 | 28 | 0 | 37317 |
| 2/22 | 23108 | 3555 | 23658 | 593 | 0 | 20 | 153 | 15477 |
| 2/23 | 35823 | 9059 | 28659 | 454 | 0 | 0 | 49 | 11540 |
| 2/24 | 42763 | 25380 | 18105 | 366 | 0 | 0 | 325 | 3879 |
| 2/25 | 10785 | 3647 | 9095 | 477 | 0 | 65 | 47 | 2570 |
| 2/26 | 7708 | 2729 | 5171 | 403 | 0 | 27 | 339 | 2367 |
| 2/27 | 5008 | 234 | 6562 | 153 | 2 | 55 | 725 | 7444 |
| 2/28 | 3171 | 3868 | 4321 | 348 | 0 | 13 | 479 | 28066 |
| 2/29 | - | - | - | 250 | - | - | - | 9232 |
| 3/1 | 712 | 3716 | 10986 | 286 | 0 | 60 | 193 | 1664 |
| 3/2 | 1094 | 3665 | 7921 | 0 | 23 | 61 | 1576 | 2872 |
| 3/3 | 610 | 3604 | 7234 | 125 | 8 | 60 | 5403 | 793 |
| 3/4 | 807 | 3755 | 6614 | 167 | 0 | 33 | 1790 | 925 |
| 3/5 | 874 | 270 | 9208 | 282 | 2 | 4 | 1787 | 848 |
| 3/6 | 2033 | 3523 | 13600 | 343 | 0 | 6 | 479 | 693 |
| 3/7 | 515 | 153 | 9378 | 232 | 0 | 104 | 1920 | 593 |
| 3/8 | 1377 | 2479 | 8288 | 70 | 0 | 60 | 1300 | 3264 |
| 3/9 | 1100 | 2423 | 5922 | 212 | 2 | 44 | 719 | 1625 |
| 3/10 | 777 | 3149 | 1884 | 70 | 0 | 45 | 5329 | 819 |
| 3/11 | 2034 | 2302 | 3032 | 114 | 0 | 73 | 4810 | 2908 |
| 3/12 | 3139 | 2225 | 3258 | 212 | 0 | 40 | 5209 | 2012 |
| 3/13 | 1732 | 72 | 1204 | 170 | 0 | 13 | 17672 | 2486 |
| 3/14 | 3771 | 153 | 1714 | 440 | 0 | 46 | 12664 | 1657 |
| 3/15 | 5090 | 72 | 1162 | 170 | 0 | 72 | 7145 | 2839 |
| 3/16 | 4577 | 153 | 411 | 140 | 15 | 33 | 5812 | 2251 |
| 3/17 | 1808 | 72 | 524 | 70 | 0 | 38 | 3365 | 2638 |
| 3/18 | 1427 | 730 | 538 | 343 | 8 | 83 | 2800 | 2728 |
| 3/19 | 811 | 784 | 382 | 184 | 0 | 18 | 717 | 3237 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3/20 | 858 | 1313 | 128 | 368 | 0 | 103 | 1066 | 4053 |
| 3/21 | 1353 | 306 | 0 | 368 | 0 | 62 | 1680 | 2405 |
| 3/22 | 1103 | 189 | 907 | 364 | 53 | 51 | 581 | 2967 |
| 3/23 | 1231 | 2255 | 1318 | 361 | 30 | 119 | 1261 | 1928 |
| 3/24 | 1183 | 14121 | 1714 | 365 | 54 | 47 | 916 | 2715 |
| 3/25 | 1125 | 15850 | 2635 | 169 | 24 | 79 | 1612 | 4605 |
| 3/26 | 1048 | 5174 | 1332 | 127 | 32 | 54 | 1083 | 3792 |
| 3/27 | 599 | 6502 | 921 | 70 | 30 | 48 | 240 | 4779 |
| 3/28 | 378 | 4375 | 808 | 28 | 15 | 39 | 99 | 2776 |
| 3/29 | 392 | 2315 | 907 | 140 | 46 | 25 | 753 | 3589 |
| 3/30 | 325 | 1404 | 397 | 184 | 53 | 20 | 94 | 5446 |
| 3/31 | 698 | 1916 | 552 | 195 | 38 | 13 | 675 | 3160 |
| 4/1 | 682 | 667 | 1318 | 422 | 15 | 31 | 594 | 2638 |
| 4/2 | 627 | 414 | 128 | 420 | 45 | 12 | 536 | 1960 |
| 4/3 | 689 | 2370 | 128 | 475 | 15 | 13 | 238 | 1590 |
| 4/4 | 351 | 2119 | 397 | 309 | 23 | 0 | 298 | 1596 |
| 4/5 | 507 | 1536 | 255 | 85 | 8 | 0 | 565 | 393 |
| 4/6 | 474 | 387 | 0 | 210 | 8 | 0 | 325 | 587 |
| 4/7 | 445 | 727 | 128 | 1576 | 8 | 6 | 271 | 1973 |
| 4/8 | 413 | 1736 | 255 | 2095 | 0 | 6 | 144 | 1148 |
| 4/9 | 329 | 710 | 538 | 591 | 15 | 13 | 194 | 1139 |
| 4/10 | 319 | 314 | 793 | 845 | 30 | 0 | 288 | 509 |
| 4/11 | 0 | 2069 | 269 | 532 | 15 | 0 | 333 | 77 |
| 4/12 | 33 | 900 | 907 | 536 | 36 | 6 | 433 | 834 |
| 4/13 | 202 | 333 | 524 | 184 | 166 | 0 | 94 | 880 |
| 4/14 | 179 | 945 | 255 | 295 | 30 | 30 | 238 | 1357 |
| 4/15 | 156 | 359 | 128 | 377 | 0 | 45 | 288 | 939 |
| 4/16 | 137 | 440 | 255 | 214 | 23 | 26 | 382 | 1161 |
| 4/17 | 153 | 286 | 666 | 0 | 0 | 59 | 524 | 842 |
| 4/18 | 0 | 32 | 397 | 153 | 38 | 51 | 191 | 632 |
| 4/19 | 94 | 359 | 397 | 254 | 43 | 27 | 284 | 77 |
| 4/20 | 0 | 503 | 128 | 228 | 44 | 43 | 196 | 1150 |
| 4/21 | 64 | 265 | 0 | 212 | 0 | 39 | 215 | 1401 |
| 4/22 | 59 | 36 | 142 | 124 | 8 | 120 | 407 | 648 |
| 4/23 | 49 | 359 | 397 | 28 | 49 | 34 | 220 | 891 |
| 4/24 | 42 | 270 | 269 | 233 | 26 | 15 | 680 | 255 |
| 4/25 | 39 | 7 | 128 | 211 | 21 | 142 | 520 | 39 |
| 4/26 | 0 | 378 | 128 | 239 | 23 | 39 | 618 | 655 |
| 4/27 | 0 | 88 | 888 | 0 | 26 | 32 | 532 | 838 |
| 4/28 | 23 | 36 | 904 | 83 | 15 | 20 | 664 | 874 |
| 4/29 | 23 | 88 | 1119 | 167 | 30 | 43 | 425 | 587 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4/30 | 20 | 7 | 1077 | 0 | 56 | 219 | 400 | 695 |
| 5/1 | 23 | 7 | 1289 | 127 | 55 | 231 | 382 | 648 |
| 5/2 | 33 | 173 | 2012 | 0 | 146 | 107 | 142 | 393 |
| 5/3 | 33 | 454 | 4137 | 239 | 30 | 26 | 335 | 39 |
| 5/4 | 10 | 183 | 1145 | 525 | 53 | 26 | 49 | 155 |
| 5/5 | 65 | 387 | 1187 | 42 | 69 | 38 | 279 | 393 |
| 5/6 | 65 | 369 | 1286 | 156 | 55 | 162 | 192 | 923 |
| 5/7 | 10 | 358 | 2506 | 28 | 8 | 77 | 470 | 1828 |
| 5/8 | 10 | 418 | 1686 | 77 | 46 | 64 | 617 | 728 |
| 5/9 | 0 | 133 | 2493 | 28 | 46 | 54 | 833 | 848 |
| 5/10 | 0 | 178 | 3825 | 132 | 56 | 40 | 650 | 332 |
| 5/11 | 65 | 323 | 1497 | 129 | 30 | 58 | 516 | 310 |
| 5/12 | 130 | 162 | 1540 | 152 | 122 | 100 | 361 | 509 |
| 5/13 | 163 | 0 | 1581 | 182 | 73 | 37 | 622 | 612 |
| 5/14 | 7 | 0 | 1411 | 85 | 91 | 57 | 811 | 1174 |
| 5/15 | 10 | 162 | 1411 | 28 | 51 | 18 | 783 | 267 |
| 5/16 | 0 | 162 | 1856 | 112 | 52 | 28 | 1148 | 948 |
| 5/17 | 33 | 234 | 1672 | 105 | 53 | 65 | 843 | 332 |
| 5/18 | 0 | 540 | 1748 | 96 | 33 | 53 | 1101 | 155 |
| 5/19 | 0 | 195 | 1775 | 0 | 30 | 39 | 1009 | 255 |
| 5/20 | 33 | 187 | 1774 | 70 | 46 | 0 | 704 | 780 |
| 5/21 | 10 | 203 | 1050 | 0 | 15 | 47 | 571 | 600 |
| 5/22 | 10 | 123 | 2111 | 125 | 32 | 49 | 489 | 455 |
| 5/23 | 0 | 123 | 1075 | No PE | 33 | 48 | 337 | 332 |
| 5/24 | 0 | 153 | 2550 | No PE | 39 | 27 | 524 | 439 |
| 5/25 | 0 | 162 | 1724 | No PE | 15 | 20 | 382 | 116 |
| 5/26 | 0 | No PE | 1707 | No PE | 0 | 67 | 429 | 987 |
| 5/27 | 0 | No PE | 2003 | No PE | 0 | 51 | 553 | 2905 |
| 5/28 | 36 | No PE | 1718 | No PE | 0 | 53 | 524 | 1048 |
| 5/29 | 55 | No PE | 10653 | No PE | 0 | 54 | 525 | 493 |
| 5/30 | 0 | No PE | 1177 | No PE | 0 | 63 | 373 | 402 |
| 5/31 | 65 | No PE | 382 | No PE | 0 | 26 | 238 | 239 |
| 6/1 | 97 | No PE | 1495 | No PE | 0 | 46 | 97 | 139 |
| 6/2 | 0 | No PE | 1449 | No PE | 0 | 6 | 47 | 116 |
| 6/3 | 98 | No PE | 1432 | No PE | 0 | 0 | 362 | 293 |
| 6/4 | 97 | No PE | 2193 | No PE | No PE | 7 | 433 | 571 |
| 6/5 | 110 | No PE | 1190 | No PE | No PE | 13 | 238 | 355 |
| 6/6 | 162 | No PE | 982 | No PE | No PE | 12 | 94 | 151 |
| 6/7 | 292 | No PE | 1291 | No PE | No PE | 0 | 335 | 139 |
| 6/8 | 0 | No PE | 1327 | No PE | No PE | 0 | 49 | 317 |
| 6/9 | 259 | No PE | 1323 | No PE | No PE | No PE | 236 | 406 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6/10 | 297 | No PE | 1281 | No PE | No PE | No PE | 219 | 193 |
| 6/11 | 224 | No PE | 638 | No PE | No PE | No PE | 261 | 0 |
| 6/12 | 240 | No PE | 382 | No PE | No PE | No PE | 219 | 139 |
| 6/13 | 163 | No PE | 255 | No PE | No PE | No PE | 242 | 255 |
| 6/14 | 261 | No PE | 142 | No PE | No PE | No PE | 0 | 77 |
| 6/15 | 280 | No PE | 1428 | No PE | No PE | No PE | 528 | 0 |
| 6/16 | 300 | No PE | 1492 | No PE | No PE | No PE | 236 | 0 |
| 6/17 | 377 | No PE | 1441 | No PE | No PE | No PE | 143 | 0 |
| 6/18 | 367 | No PE | 128 | No PE | No PE | No PE | 138 | 0 |
| 6/19 | 331 | No PE | 0 | No PE | No PE | No PE | 138 | 0 |
| 6/20 | 455 | No PE | 0 | No PE | No PE | No PE | 149 | 0 |
| 6/21 | 326 | No PE | No PE | No PE | No PE | No PE | 193 | 0 |
| 6/22 | 128 | No PE | No PE | No PE | No PE | No PE | 94 | 0 |
| 6/23 | 128 | No PE | No PE | No PE | No PE | No PE | 94 | 0 |
| 6/24 | No PE | No PE | No PE | No PE | No PE | No PE | 120 | 0 |
| 6/25 | No PE | No PE | No PE | No PE | No PE | No PE | 158 | 0 |
| 6/26 | No PE | No PE | No PE | No PE | No PE | No PE | 288 | 0 |
| 6/27 | No PE | No PE | No PE | No PE | No PE | No PE | 522 | 0 |
| 6/28 | No PE | No PE | No PE | No PE | No PE | No PE | 76 | 0 |
| 6/29 | No PE | No PE | No PE | No PE | No PE | No PE | 333 | NS |
| 6/30 | No PE | No PE | No PE | No PE | No PE | No PE | 99 | NS |
| 7/1 | No PE | No PE | No PE | No PE | No PE | No PE | 76 | NS |
| 7/2 | No PE | No PE | No PE | No PE | No PE | No PE | 80 | NS |
| 7/3 | No PE | No PE | No PE | No PE | No PE | No PE | 80 | NS |
| 7/4 | No PE | No PE | No PE | No PE | No PE | No PE | 80 | NS |
| 7/5 | No PE | No PE | No PE | No PE | No PE | No PE | 94 | NS |
| 7/6 | No PE | No PE | No PE | No PE | No PE | No PE | 94 | NS |
| 7/7 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | NS |
| 7/8 | No PE | No PE | No PE | No PE | No PE | No PE | 104 | NS |
| 7/9 | No PE | No PE | No PE | No PE | No PE | No PE | 146 | NS |
| 7/10 | No PE | No PE | No PE | No PE | No PE | No PE | 47 | NS |
| 7/11 | No PE | No PE | No PE | No PE | No PE | No PE | 118 | NS |
| 7/12 | No PE | No PE | No PE | No PE | No PE | No PE | 47 | No PE |
| 7/13 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | No PE |
| 7/14 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | No PE |
| 7/15 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | No PE |
| 7/16 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | No PE |
| 7/17 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | No PE |
| 7/18 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | No PE |
| 7/19 | No PE | No PE | No PE | No PE | No PE | No PE | 0 | 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 6:** **Genetic results for fin-clip samples from Chinook Salmon caught in the Stanislaus River during the 2024 sampling season.**

| Date | Sample # | LAD Run | SNP Run | SNP | Final Run | FL | W |
|---|---|---|---|---|---|---|---|
| 1/21/2024 | 4184-001 | Fall | Fall | 0.99 | Fall | 39 | - |
| 1/24/2024 | 4184-002 | Fall | Fall | 1.00 | Fall | 36 | - |
| 1/24/2024 | 4184-003 | Fall | Fall | 0.99 | Fall | 34 | - |
| 1/28/2024 | 4184-004 | Fall | No Call | - | Fall | 37 | - |
| 1/28/2024 | 4184-005 | Fall | Fall | 1.00 | Fall | 37 | - |
| 1/28/2024 | 4184-006 | Fall | Fall | 1.00 | Fall | 36 | - |
| 2/7/2024 | 4184-007 | Fall | Fall | 1.00 | Fall | 34 | - |
| 2/7/2024 | 4184-008 | Fall | Fall | 1.00 | Fall | 40 | 0.6 |
| 2/11/2024 | 4184-010 | Fall | Fall | 1.00 | Fall | 36 | - |
| 2/11/2024 | 4184-011 | Fall | Fall | 1.00 | Fall | 39 | - |
| 2/11/2024 | 4184-012 | Fall | Fall | 1.00 | Fall | 36 | - |
| 2/19/2024 | 4184-013 | Fall | Fall | 1.00 | Fall | 37 | - |
| 2/19/2024 | 4184-014 | Fall | Fall | 1.00 | Fall | 37 | - |
| 2/19/2024 | 4184-015 | Fall | Fall | 1.00 | Fall | 44 | 1.1 |
| 2/26/2024 | 4184-016 | Fall | Fall | 1.00 | Fall | 34 | - |
| 2/26/2024 | 4184-017 | Fall | Fall | 1.00 | Fall | 35 | - |
| 3/3/2024 | 4184-019 | Fall | Fall | 1.00 | Fall | 50 | 1.4 |
| 3/3/2024 | 4184-022 | Fall | Fall | 1.00 | Fall | 37 | - |
| 3/3/2024 | 4184-021 | Fall | Fall | 1.00 | Fall | 33 | - |
| 3/5/2024 | 4184-023 | Spring | Fall | 1.00 | Fall | 63 | 2.6 |
| 3/7/2024 | 4184-024 | Spring | Fall | 1.00 | Fall | 63 | 2.6 |
| 3/10/2024 | 4184-027 | Fall | Fall | 1.00 | Fall | 34 | - |
| 3/10/2024 | 4184-025 | Fall | Fall | 1.00 | Fall | 50 | 1.0 |
| 3/10/2024 | 4184-026 | Fall | Fall | 1.00 | Fall | 52 | 1.4 |
| 3/17/2024 | 4184-028 | Fall | Fall | 0.98 | Fall | 49 | 1.1 |
| 3/17/2024 | 4184-029 | Fall | Fall | 1.00 | Fall | 37 | - |
| 3/17/2024 | 4184-030 | Fall | Fall | 1.00 | Fall | 42 | 0.6 |
| 3/22/2024 | 4184-031 | Spring | Fall | 1.00 | Fall | 70 | 3.7 |
| 3/24/2024 | 4184-033 | Fall | Fall | 1.00 | Fall | 49 | 0.8 |
| 3/24/2024 | 4184-034 | Fall | Fall | 1.00 | Fall | 49 | 1.3 |
| 3/24/2024 | 4184-032 | Fall | Fall | 1.00 | Fall | 49 | - |
| 3/29/2024 | 4184-035 | Spring | Fall | 1.00 | Fall | 82 | 6.5 |
| 3/31/2024 | 4184-038 | Fall | Fall | 0.97 | Fall | 48 | 0.9 |
| 3/31/2024 | 4184-036 | Fall | Fall | 1.00 | Fall | 56 | 1.6 |
| 3/31/2024 | 4184-037 | Fall | Fall | 1.00 | Fall | 48 | 0.9 |
| 4/3/2024 | 4184-039 | Spring | Fall | 1.00 | Fall | 75 | 4.6 |
| 4/6/2024 | 4184-050 | Spring | Fall | 1.00 | Fall | 82 | 6.5 |
| 4/6/2024 | 4184-040 | Spring | Fall | 1.00 | Fall | 78 | 4.7 |
| 4/7/2024 | 4184-047 | Fall | Fall | 1.00 | Fall | 38 | - |
| 4/7/2024 | 4184-041 | Spring | Fall | 1.00 | Fall | 87 | 7.5 |
| 4/7/2024 | 4184-042 | Spring | Fall | 1.00 | Fall | 87 | 8.2 |
| 4/7/2024 | 4184-043 | Spring | Fall | 1.00 | Fall | 84 | 6.4 |
| 4/7/2024 | 4184-045 | Spring | Fall | 0.97 | Fall | 84 | 6.9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4/7/2024 | 4184-046 | Spring | Fall | 1.00 | Fall | 79 | 5.9 |
| 4/8/2024 | 4184-051 | Fall | No Call | - | Fall | 49 | 0.8 |
| 4/8/2024 | 4184-044 | Spring | Fall | 0.83 | Fall | 86 | 7.0 |
| 4/8/2024 | 4184-049 | Spring | Fall | 1.00 | Fall | 85 | 7.1 |
| 4/10/2024 | 4184-052 | Spring | Fall | 1.00 | Fall | 94 | 9.1 |
| 4/10/2024 | 4184-053 | Spring | Fall | 1.00 | Fall | 85 | 6.9 |
| 4/12/2024 | 4183-001 | Spring | Fall | 1.00 | Fall | 98 | 10.1 |
| 4/13/2024 | 4184-055 | Spring | Fall | 1.00 | Fall | 81 | 5.6 |
| 4/13/2024 | 4184-056 | Spring | Fall | 1.00 | Fall | 97 | 10.6 |
| 4/13/2024 | 4184-057 | Spring | Fall | 1.00 | Fall | 81 | 5.8 |
| 4/13/2024 | 4184-058 | Spring | No Call | - | Fall | 85 | 7.4 |
| 4/13/2024 | 4184-059 | Spring | Fall | 1.00 | Fall | 79 | 5.4 |
| 4/13/2024 | 4184-060 | Spring | Fall | 1.00 | Fall | 82 | 5.8 |
| 4/14/2024 | 4184-075 | Fall | Fall | 1.00 | Fall | 43 | 0.6 |
| 4/14/2024 | 4184-061 | Spring | Fall | 1.00 | Fall | 92 | 8.9 |
| 4/14/2024 | 4184-062 | Spring | Fall | 1.00 | Fall | 86 | 8.9 |
| 4/14/2024 | 4184-072 | Fall | Fall | 1.00 | Fall | 74 | 4.8 |
| 4/14/2024 | 4184-076 | Fall | Fall | 1.00 | Fall | 47 | 1.0 |
| 4/14/2024 | 4184-063 | Spring | Fall | 1.00 | Fall | 81 | 6.6 |
| 4/14/2024 | 4184-064 | Spring | Fall | 1.00 | Fall | 80 | 6.1 |
| 4/14/2024 | 4184-065 | Spring | Fall | 1.00 | Fall | 85 | 7.2 |
| 4/14/2024 | 4184-066 | Spring | Fall | 1.00 | Fall | 86 | 7.7 |
| 4/14/2024 | 4184-067 | Spring | Fall | 1.00 | Fall | 80 | 6.0 |
| 4/14/2024 | 4184-068 | Spring | No Call | - | Fall | 87 | 7.2 |
| 4/14/2024 | 4184-069 | Spring | Fall | 1.00 | Fall | 81 | 5.2 |
| 4/14/2024 | 4184-070 | Spring | Fall | 1.00 | Fall | 88 | 7.7 |
| 4/14/2024 | 4184-071 | Spring | Fall | 1.00 | Fall | 80 | 5.7 |
| 4/14/2024 | 4184-073 | Spring | Fall | 1.00 | Fall | 81 | 5.6 |
| 4/15/2024 | 4184-054 | Spring | Fall | 1.00 | Fall | 80 | 5.4 |
| 4/16/2024 | 4184-077 | Spring | Fall | 1.00 | Fall | 81 | 5.7 |
| 4/16/2024 | 4184-078 | Spring | Fall | 1.00 | Fall | 86 | 6.5 |
| 4/16/2024 | 4184-079 | Spring | No Call | - | Fall | 86 | - |
| 4/16/2024 | 4184-080 | Spring | Fall | 1.00 | Fall | 82 | 6.1 |
| 4/16/2024 | 4184-081 | Spring | Fall | 0.94 | Fall | 85 | 6.8 |
| 4/16/2024 | 4184-082 | Spring | Fall | 0.99 | Fall | 94 | 8.1 |
| 4/16/2024 | 4184-083 | Spring | Fall | 1.00 | Fall | 82 | 5.1 |
| 4/16/2024 | 4184-084 | Spring | Fall | 1.00 | Fall | 81 | 6.4 |
| 4/17/2024 | 4184-086 | Spring | Fall | 1.00 | Fall | 87 | 6.7 |
| 4/17/2024 | 4184-085 | Spring | No Call | - | Fall | 84 | 6.3 |
| 4/18/2024 | 4184-089 | Spring | Fall | 1.00 | Fall | 93 | 8.9 |
| 4/18/2024 | 4184-090 | Spring | Fall | 1.00 | Fall | 84 | 6.0 |
| 4/18/2024 | 4184-087 | Spring | No Call | - | Fall | 83 | 6.1 |
| 4/18/2024 | 4184-088 | Spring | Fall | 1.00 | Fall | 85 | 6.5 |
| 4/19/2024 | 4184-091 | Spring | Fall | 1.00 | Fall | 84 | 5.8 |
| 4/19/2024 | 4184-092 | Spring | Fall | 1.00 | Fall | 87 | 6.9 |
| 4/20/2024 | 4184-093 | Spring | Fall | 1.00 | Fall | 85 | 6.8 |

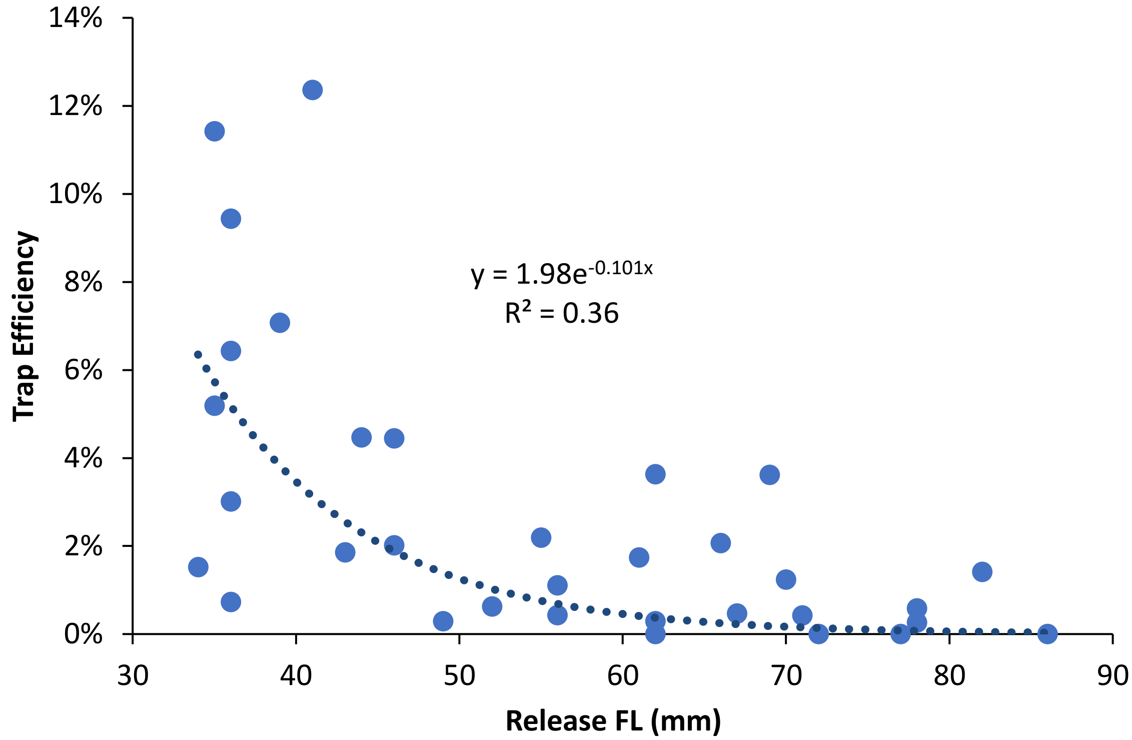
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4/20/2024 | 4184-094 | Spring | No Call | - | Fall | 83 | 6.5 |
| 4/21/2024 | 4184-095 | Fall | No Call | - | Fall | 79 | 6.2 |
| 4/21/2024 | 4184-098 | Fall | Fall | 1.00 | Fall | 72 | 3.9 |
| 4/22/2024 | 4184-097 | Spring | Fall | 0.99 | Fall | 86 | 7.0 |
| 4/26/2024 | 4183-004 | Spring | Fall | 1.00 | Fall | 87 | 6.3 |
| 4/26/2024 | 4183-002 | Spring | Fall | 1.00 | Fall | 89 | 7.5 |
| 4/26/2024 | 4183-003 | Spring | Fall | 1.00 | Fall | 92 | 7.6 |
| 4/28/2024 | 4184-099 | Spring | Fall | 0.98 | Fall | 90 | 7.8 |
| 4/29/2024 | 4183-031 | Fall | Fall | 1.00 | Fall | 81 | 6.2 |
| 4/29/2024 | 4184-100 | Spring | Fall | 1.00 | Fall | 94 | 10.0 |
| 4/29/2024 | 4183-032 | Fall | Fall | 1.00 | Fall | 80 | 5.6 |
| 4/29/2024 | 4183-033 | Fall | Fall | 1.00 | Fall | 73 | 4.1 |
| 5/2/2024 | 4183-005 | Spring | Fall | 0.98 | Fall | 90 | 6.7 |
| 5/2/2024 | 4183-006 | Spring | Fall | 1.00 | Fall | 96 | 8.5 |
| 5/3/2024 | 4183-007 | Spring | Fall | 0.99 | Fall | 97 | 9.9 |
| 5/5/2024 | 4183-034 | Fall | Fall | 1.00 | Fall | 80 | 6.0 |
| 5/5/2024 | 4183-036 | Fall | Fall | 1.00 | Fall | 86 | 7.2 |
| 5/5/2024 | 4183-037 | Fall | No Call | - | Fall | 86 | 6.8 |
| 5/5/2024 | 4183-035 | Spring | Fall | 1.00 | Fall | 95 | 9.5 |
| 5/6/2024 | 4183-038 | Spring | Fall | 1.00 | Fall | 95 | 10.3 |
| 5/7/2024 | 4183-039 | Spring | Fall | 1.00 | Fall | 93 | 9.0 |
| 5/7/2024 | 4183-040 | Spring | Fall | 1.00 | Fall | 94 | 9.1 |
| 5/8/2024 | 4183-041 | Spring | Fall | 1.00 | Fall | 103 | 11.8 |
| 5/9/2024 | 4183-008 | Spring | Fall | 1.00 | Fall | 99 | 9.9 |
| 5/11/2024 | 4183-042 | Spring | Fall | 1.00 | Fall | 102 | 10.5 |
| 5/11/2024 | 4183-043 | Spring | Fall | 1.00 | Fall | 97 | 9.4 |
| 5/12/2024 | 4183-046 | Fall | Fall | 1.00 | Fall | 84 | 6.2 |
| 5/12/2024 | 4183-044 | Fall | Fall | 1.00 | Fall | 93 | 9.0 |
| 5/12/2024 | 4183-045 | Fall | Fall | 1.00 | Fall | 77 | 5.0 |
| 5/14/2024 | 4183-047 | Spring | Fall | 0.99 | Fall | 110 | 15.5 |
| 5/16/2024 | 4183-010 | Spring | No Call | - | Fall | 104 | 10.4 |
| 5/17/2024 | 4183-011 | Spring | Fall | 1.00 | Fall | 99 | - |
| 5/20/2024 | 4183-048 | Fall | Fall | 1.00 | Fall | 81 | 6.2 |
| 5/20/2024 | 4183-049 | Fall | Fall | 1.00 | Fall | 78 | 5.2 |
| 5/20/2024 | 4183-050 | Fall | Fall | 1.00 | Fall | 67 | 3.0 |
| 5/26/2024 | 4183-051 | Fall | Fall | 1.00 | Fall | 81 | 5.6 |
| 5/26/2024 | 4183-052 | Fall | Fall | 0.99 | Fall | 83 | 6.4 |
| 6/2/2024 | 4183-053 | Fall | Fall | 0.99 | Fall | 89 | 7.0 |
| 6/2/2024 | 4183-054 | Fall | Fall | 1.00 | Fall | 84 | 6.8 |
| 6/2/2024 | 4183-055 | Fall | Fall | 1.00 | Fall | 94 | 9.0 |
| 6/4/2024 | 4183-056 | Spring | Fall | 1.00 | Fall | 116 | 18.2 |
| 6/10/2024 | 4183-057 | Fall | Fall | 1.00 | Fall | 105 | 12.5 |
| 6/10/2024 | 4183-058 | Fall | Fall | 1.00 | Fall | 101 | 11.3 |
| 6/10/2024 | 4183-059 | Fall | No Call | - | Fall | 85 | 7.2 |

**Appendix 7:** **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 Stanislaus River RST sampling season.**

| Common Name | January Avg (Range, *n*) | February Avg (Range, *n*) | March Avg (Range, | April Avg (Range, n) | May Avg (Range, n) | June Avg (Range, n) |
|---|---|---|---|---|---|---|
| Bigscale logperch | - | 77 (77, *n* = 1) | - | - | - | - |
| Black crappie | 105 (71 - 138, *n* = 2) | 137 (137, *n* = 1) | - | - | 45 (41 - 52, *n* = 4) | - |
| Bluegill | 64 (28 - 153, *n* = 17) | 137 (128 - 146, *n* = 2) | 30 (25 - 36, *n* = 7) | 36 (22 - 104, *n* = 35) | 44 (15 - 135, *n* = 13) | 26 (22 - 28, *n* = 3) |
| Brown bullhead | NA (NA, *n* = 1) | - | - | - | - | - |
| Channel catfish | 85 (85, *n* = 1) | - | - | - | - | - |
| Common carp | 87 (66 - 116, *n* = 12) | 82 (59 - 156, *n* = 10) | 88 (65 - 100, *n* = 4) | 80 (80, *n* = 1) | - | - |
| Golden shiner | 105 (96 - 113, *n* = 2) | 79 (44 - 113, *n* = 10) | 55 (45 - 71, *n* = 7) | 49 (45 - 55, *n* = 5) | 55 (40 - 119, *n* = 7) | 51 (43 - 59, *n* = 3) |
| Green sunfish | - | - | - | 141 (141, *n* = 1) | - | - |
| Hardhead | 110 (110, *n* = 1) | - | - | 140 (107 - 185, *n* = 3) | 186 (186, *n* = 1) | - |
| Hitch | - | - | 124 (113 - 134, *n* = 2) | 113 (107 - 124, *n* = 3) | - | - |
| Largemouth bass | 68 (59 - 83, *n* = 11) | 64 (64, *n* = 1) | 61 (55 - 64, *n* = 4) | 62 (55 - 71, *n* = 4) | 70 (70, *n* = 1) | 105 (105, *n* = 1) |
| Pacific lamprey | 127 (86 - 157, *n* = 139) | 127 (108 - 142, *n* = 13) | 139 (137 - 141, *n* = 2) | 132 (120 - 142, *n* = 8) | - | - |
| Prickly sculpin | 125 (86 - 78, *n* = 4) | 86 (78 - 95, *n* = 3) | 87 (76 - 100, *n* = 5) | 71 (60 - 80, *n* = 3) | 78 (64 - 91, *n* = 3) | 60 (60, *n* = 1) |
| Red shiner | - | - | - | - | - | 55 (55, *n* = 1) |
| Redear sunfish | 126 (55 - 200, *n* = 7) | - | 82 (82, *n* = 1) | - | 172 (172, *n* = 2) | - |
| Riffle sculpin | 62 (59 - 65, *n* = 2) | 56 (55 - 57, *n* = 2) | - | 67 (63 - 71, *n* = 2) | - | - |

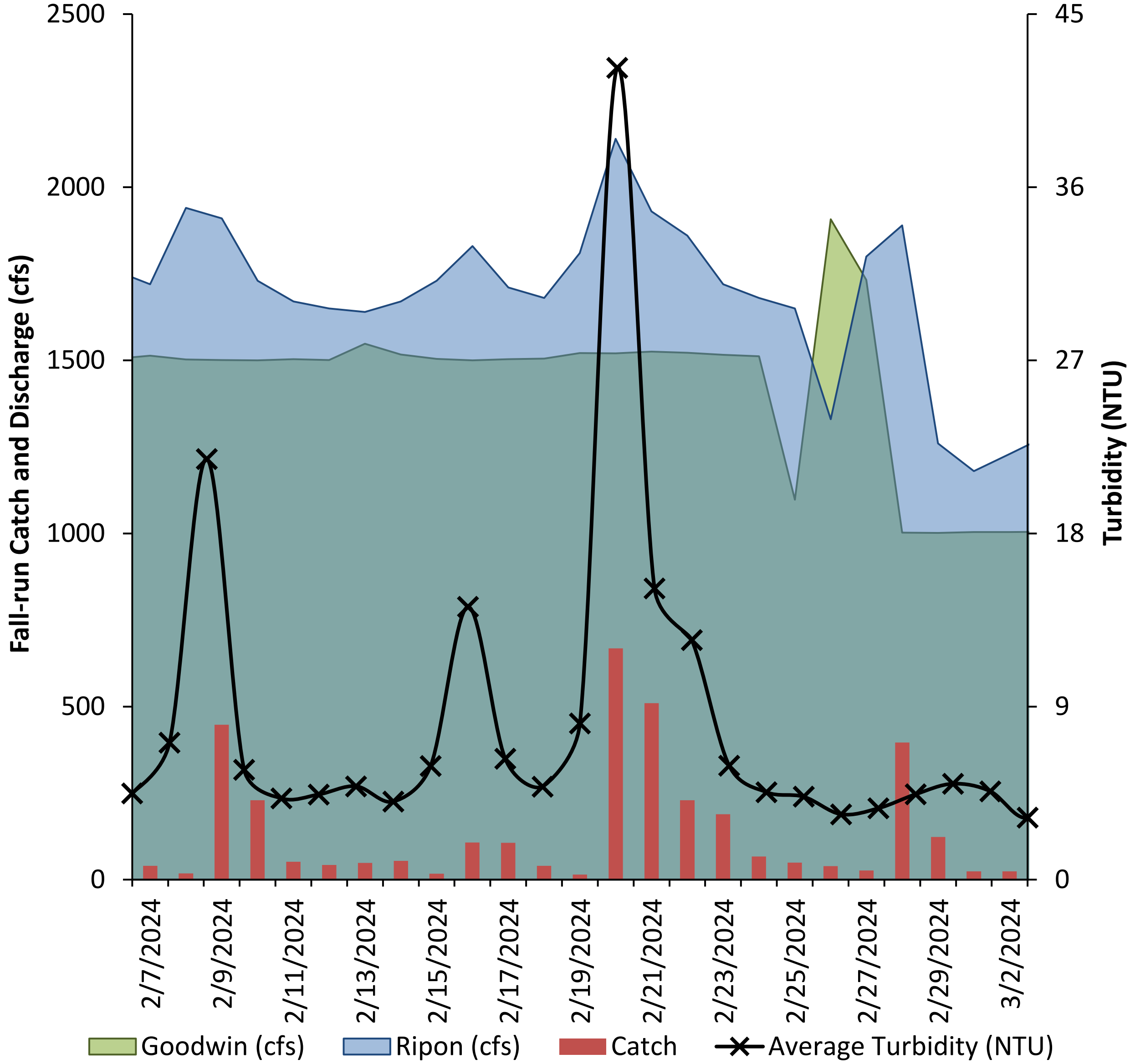
| | | | | | | |
|---|---|---|---|---|---|---|
| Sacramento pikeminnow | 100 (83 - 124, *n* = 3) | 120 (120, *n* = 1) | 127 (127, *n* = 2) | 113 (93 - 142, *n* = 6) | 97 (48 - 181, *n* = 6) | 48 (44 - 52, *n* = 3) |
| Sacramento sucker | 32 (28 - 37, *n* = 5) | 53 (28 - 86, *n* = 9) | 58 (28 - 154, *n* = 7) | 73 (29 - 117, *n* = 2) | - | 30 (25 - 35, *n* = 9) |
| Smallmouth bass | 74 (74, *n* = 1) | - | 63 (63, *n* = 1) | - | 175 (110 - 240, *n* = 2) | 172 (110 - 287, *n* = 7) |
| Sacramento Splittail | 83 (70 - 106, *n* = 11) | 83 (72 - 92, *n* = 9) | 92 (76 - 113, *n* = 7) | 82 (75 - 93, *n* = 4) | 86 (86, *n* = 1) | - |
| Spotted bass | 66 (53 - 112, *n* = 82) | 69 (55 - 83, *n* = 19) | 73 (57 - 235, *n* = 35) | 102 (56 - 312, *n* = 52) | 179 (68 - 255, *n* = 25) | 227 (52 - 261, *n* = 14) |
| Striped bass | - | - | - | - | - | 153 (153, *n* = 1) |
| Threadfin shad | 40 (32 - 47, *n* = 6) | 40 (38 - 42, *n* = 2) | 41 (41, *n* = 1) | - | - | - |
| Tule perch | 89 (89, *n* = 1) | - | - | - | - | - |
| Unknown | - | - | - | 75 (75, *n* = 1) | NA (NA, *n* = 4) | - |
| Unknown bass | - | - | - | - | - | 23 (18 - 27, *n* = 3) |
| Unknown catfish | - | - | NA (NA, *n* = 1) | - | - | - |
| Unknown Centrarchid | - | - | - | - | 23 (23, *n* = 2) | 36 (21 - 51, *n* = 2) |
| Unknown lamprey | - | 140 (140, *n* = 1) | 95 (94 - 96, *n* = 2) | 94 (68 - 133, *n* = 3) | 135 (124 - 144, *n* = 5) | - |
| Unknown | 27 (27, *n* = 1) | - | - | - | 15 (15, *n* = 1) | - |
| Unknown sunfish | 28 (28, *n* = 1) | - | - | 25 (25, *n* = 1) | 16 (12 - 19, *n* = 2) | 25 (25, *n* = 1) |
| Wakasagi | 30 (30, *n* = 1) | - | - | - | - | - |
| Warmouth | - | 170 (170, *n* = 1) | - | - | 84 (84, *n* = 1) | - |
| Western mosquitofish | 31 (21 - 46, *n* = 7) | 26 (23 - 29, *n* = 2) | 32 (25 - 52, *n* = 9) | 29 (17 - 40, *n* = 6) | 27 (27, *n* = 1) | 30 (24 - 42, *n* = 6) |
| White catfish | 94 (51 - 248, *n* = 8) | 66 (66, *n* = 1) | 56 (56, *n* = 1) | 62 (53 - 71, *n* = 5) | 147 (63 - 222, *n* = 9) | 229 (198 - 260, *n* = 3) |
| White crappie | - | - | - | - | 39 (22 - 50, *n* = 6) | 46 (34 - 58, *n* = 2) |

**Appendix 8: Trap efficiency from 2017 through 2024 as a function of release fork length of Chinook Salmon used in trap efficiency trials.**

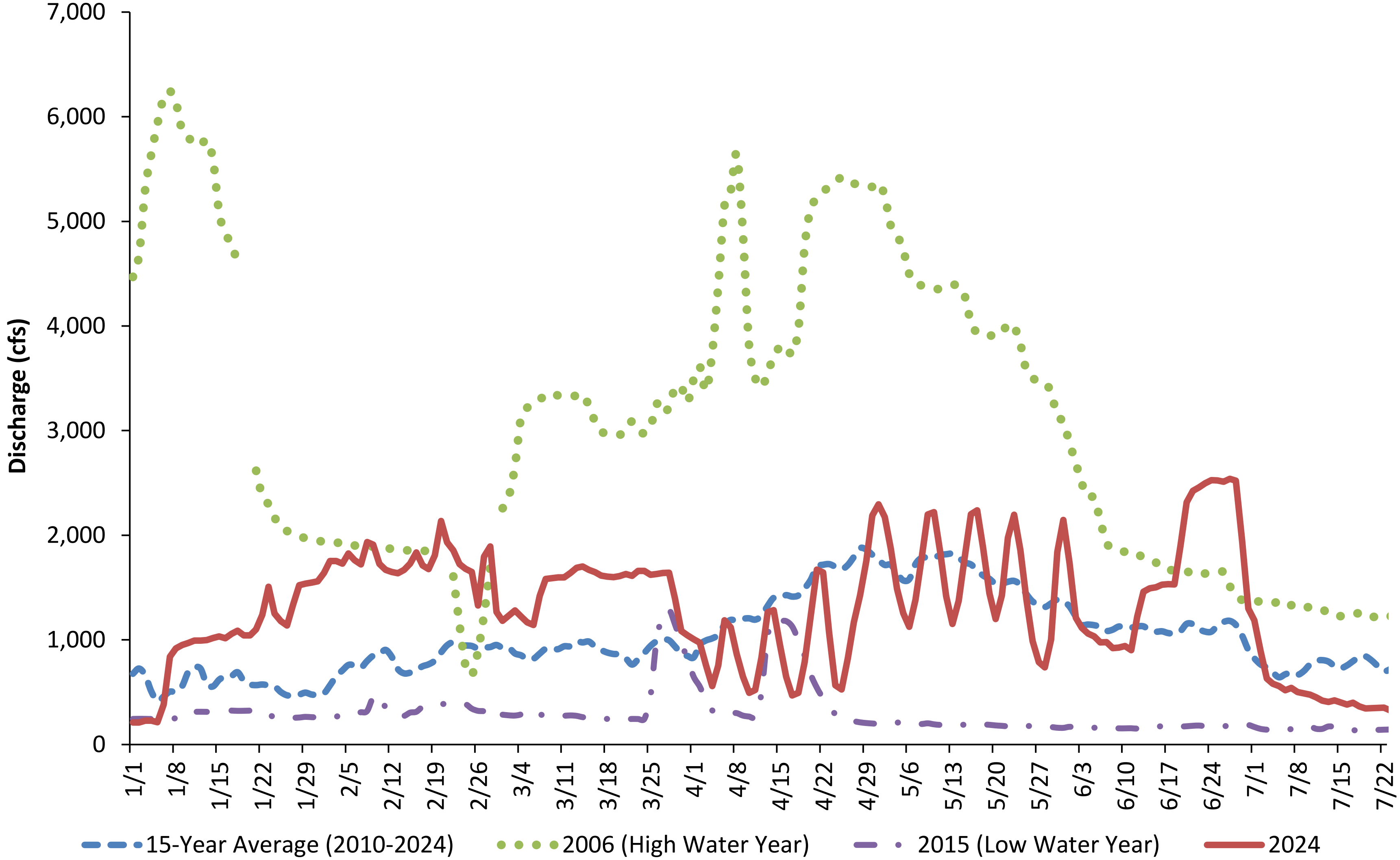



| Release Fork Length (mm) | *n* | Trap Efficiency Avg (Range) |
|---|---|---|
| 30 - 40 | 8 | 5.60 (0.73 - 11.42) |
| 41 - 50 | 6 | 4.24 (0.29 - 12.36) |
| 51 - 60 | 4 | 1.09 (0.43 - 2.19) |
| 61 - 70 | 8 | 1.63 (0.00 - 3.63) |
| >70 | 7 | 0.38 (0.00 - 1.41) |

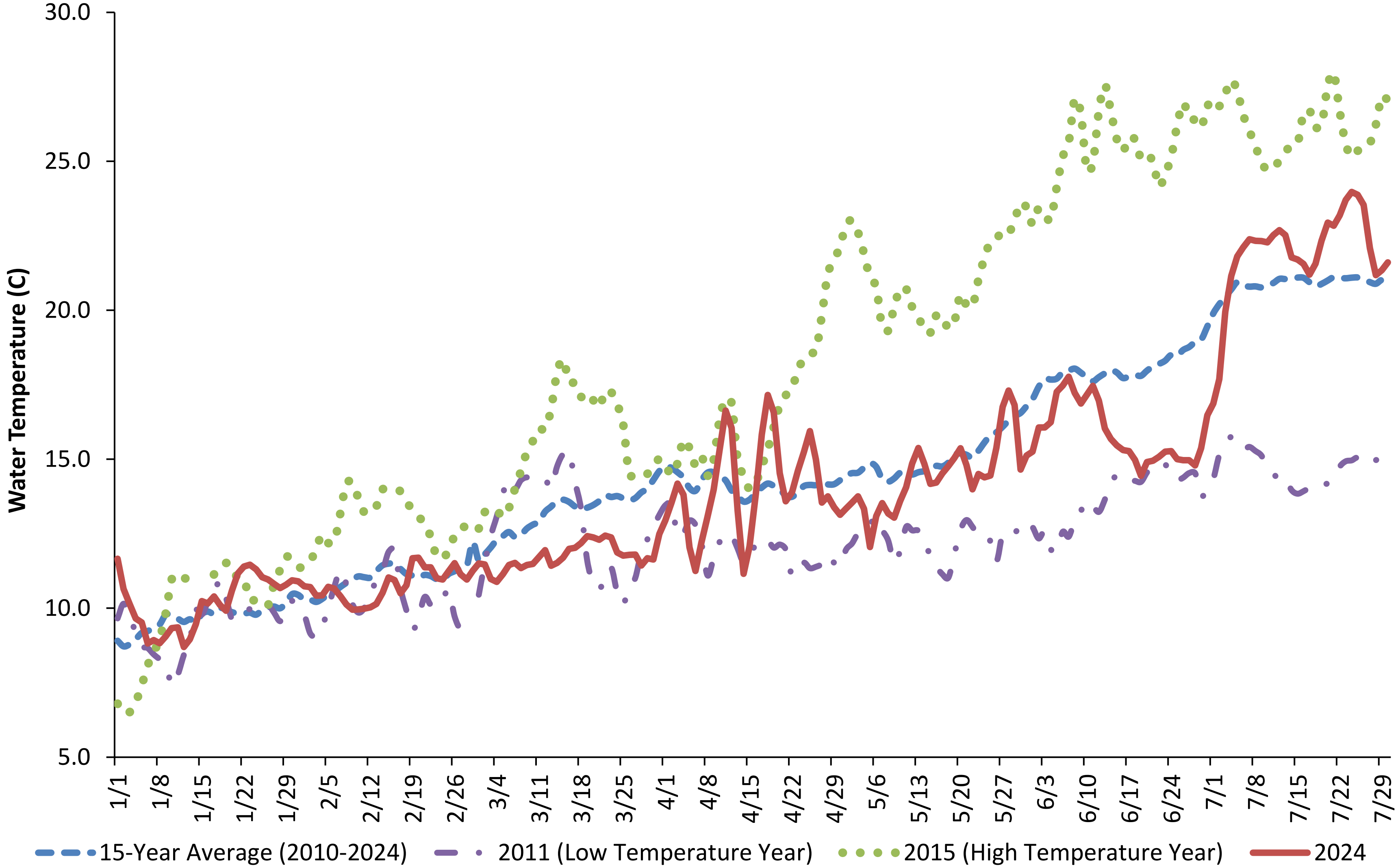
**Appendix 9:** **Fall-run Chinook Salmon catch, discharge at Goodwin Dam and Ripon (cfs), and turbidity (NTU) at the Caswell RSTs between February 7 and March 2, 2024.**



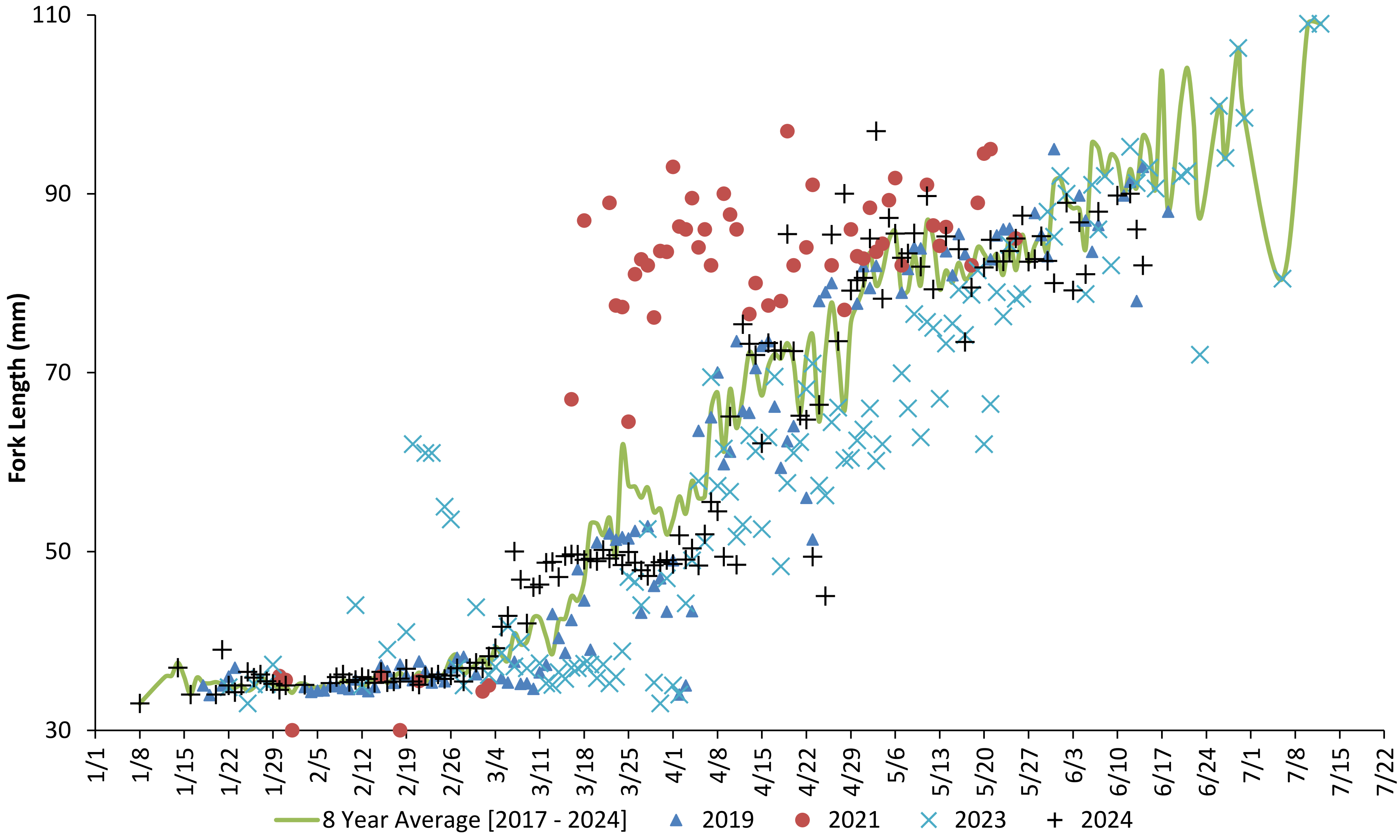
**Appendix 10:** **Daily average discharge (cfs) on the Stanislaus River at Ripon for the 15-year period 2010 – 2024 (blue dashes), a high water year in 2006 (green round dots), a low water year in 2015 (purple dash dots) and the current year (2024, red line). Data from USGS station number 11303000.**



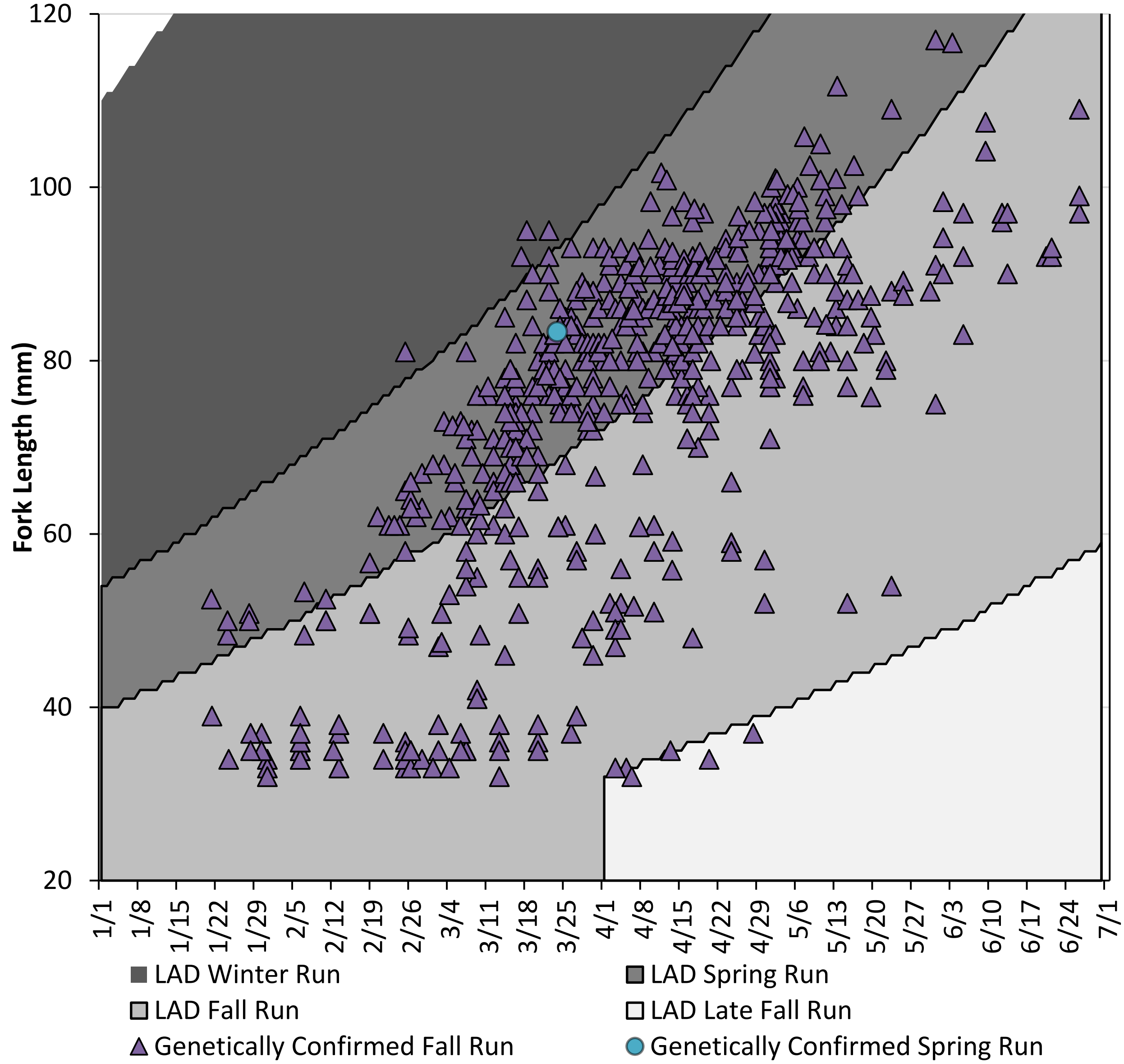
**Appendix 11:** **Daily average water temperature (°C) in the Stanislaus River at Ripon for the 15-year period 2010-2024 (blue dashes), a high temperature year in 2015 (green round dots), a low temperature year in 2011 (purple dash dots) and the current year (2024, red line). Data from USGS station number 11303000.**



**Appendix 12:** **Daily average fork length (mm) from 2017 – 2024 (green line), a high water temperature year in 2021 (red round dots), two low water temperature years in 2019 (blue triangles) and 2023 (light blue x's) and the current year (2024, black crosses).**



**Appendix 13:** **Daily fork length distribution of SNP genetically sampled natural origin Chinook Salmon from 2017 through 2024.**




| LAD Run Assignment | SNP Confirmed Fall-Run | SNP Confirmed Late Fall-Run | SNP Confirmed Spring-Run |
|---|---|---|---|
| LAD Fall | 295 | 0 | 0 |
| LAD Late Fall | 6 | 0 | 0 |
| LAD Spring | 321 | 0 | 1 |
| LAD Winter | 4 | 0 | 0 |