

2022 Adult Spring-Run Chinook Salmon Monitoring and Trap and Haul in the San Joaquin River Restoration Area

2022 SJRRP Project Report



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Program Report

2022 SJRRP Project Report

Self-Certification of Peer Review

This report has been peer reviewed by the following two individuals, at least one of whom is from outside my work group:

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I certify that, to my best knowledge, these individuals are qualified to review this work, and that they have peer reviewed this report.

PI Signature

Contents

1.0	Introduction	1
1.1	Background.....	1
1.2	Objectives	2
2.0	Materials and Methods.....	2
2.1	Study Area and Sampling Duration	2
2.2	Sampling Equipment and Operation	3
2.3	Fish Processing, Transport, and Release	6
3.0	Results and Discussion	7
4.0	References	15
5.0	Appendix.....	17
5.1	Appendix A — 2022 Spring-Run Chinook Salmon Adult Trap and Haul Site-Specific Pictures.....	17
5.2	Appendix B — Summary of non-salmonids (bycatch).....	22
5.3	Appendix C — Adult Chinook Salmon Post-Transport Processing	23

1.0 Introduction

1.1 Background

California's upper San Joaquin River (SJR) historically supported stable populations of spring-run Chinook Salmon (*Oncorhynchus tshawytscha*; Yoshiyama et al. 1998). Water management infrastructure erected on the SJR (i.e., Sack Dam, Mendota Dam, and Friant Dam) to support the expansion of agricultural production in California's Central Valley blocked migration pathways and access to suitable over summer holding and spawning habitat, which contributed to the extirpation of adult spring-run Chinook Salmon from the system (Moyle 2002). In response to the current state of Chinook Salmon, and other species in the upper SJR, a lawsuit was filed on the behalf of a coalition of environmental groups challenging the renewal of long-term water contracts. The 18-year lawsuit resulted in a settlement in which two primary goals were established: (1) to restore a naturally reproducing and self-sustaining population of Chinook Salmon as well as other fishes in the system (Restoration Goal), and (2) to reduce impacts on water supply to the contractors (Water Management Goal). The San Joaquin River Restoration Program (SJRRP) was established to achieve the goals of the settlement (<http://www.restoresjr.net/>) and is supported by collaborative groups of scientists and managers, from multiple state and federal implementing agencies. The SJRRP Fisheries Management Plan (SJRRP 2010) and Fisheries Framework (SJRRP 2018) define criteria for goals and objectives specific to re-establishing populations of Chinook Salmon in the SJRRP Restoration Area (RA; San Joaquin River from Merced River confluence to Friant Dam).

Strategies to reestablish spring-run Chinook Salmon within the SJRRP Restoration Area (as per SJRRP 2011) have included releases of translocated juvenile salmon sourced from Feather River as well as artificial propagation of spring-run Chinook Salmon produced from the Interim Salmon Conservation and Research Facility (SCARF), as permitted by the National Marine Fisheries Service (NMFS) under the authority of Section 10(a)(1)(A) of the Endangered Species Act of 1973 (Permit 20571). Releases of translocated juveniles occurred from 2014 through 2016, with the SJRRP relying solely on artificial propagation of spring-run Chinook Salmon as its primary strategy to reestablish juveniles since 2016. These efforts, and subsequent monitoring efforts, have provided evidence of adult spring-run salmon returning to the RA in 2017, 2019–22 (Hutcherson et al. 2020; Sutphin and Root 2021). Until fish passage construction projects are complete, adult salmon returning to the RA will not have access to suitable holding and spawning habitat in the upper reaches of the RA during most water years. Therefore, enumerating, trapping, and truck-transporting adult salmon from the lower reaches to the upper reaches of the RA is necessary to permit evaluation of the biological objectives for naturally returning salmonids established in the SJRRP Fisheries Framework (Table 7 in SJRRP 2018 Fisheries Framework). Trap and haul efforts will continue until in-river fish passage structures are constructed, and volitional passage is achieved, and may also be necessary during Critical Years if fish passage structures prove ineffective during such conditions.

1.2 Objectives

The primary objective of this effort was to capture adult salmon entering the lower reaches of the RA and transport them around in-river migration impediments for release into the upper reaches of the RA. Transporting salmon to the upper reaches of the RA will provide them access to suitable spawning habitat and support additional monitoring efforts (e.g., adult holding and spawning and juvenile monitoring studies). This effort provides crude estimates of annual adult escapement, as well as immigration timing and factors effecting immigration. Capture, transport and release of naturally returning adult salmon into the upper reaches of the RA supports multiple efforts to quantify criteria specified in the Fisheries Framework, including, but not limited to: pre-spawn adult survival, adult holding and spawning habitat, female fecundity, egg survival to fry emergence, juvenile growth, survival rate, production, and diversity of juveniles emigrating from the RA (SJRRP 2018). Successful spawning and subsequent production of truck-transported individuals may help increase success of spring-run reintroduction if progeny are able to successfully emigrate and return as adults. In addition, coded wire tag, passive integrated transponder tag, and tissue(s) collected for genetic analyses provide important information pertaining to age class, juvenile release date and release strategy, and familial genetics. Capture and truck-transport of adult spring-run salmon in the RA during their immigration period can reduce duration of exposure to challenging environmental conditions, including, but not limited to, elevated temperatures, waterborne toxins, and false immigrational pathways. Nonetheless, biologists working for the SJRRP will continue to evaluate salmon survival during these described processes and consider best scientific practices for fish handling and transport to maximize health and survival.

2.0 Materials and Methods

2.1 Study Area and Sampling Duration

Study Area– The SJRRP RA extends upstream approximately 150 river miles (RM) from the Merced River confluence (Stanislaus County) to Friant Dam (Fresno County; Figure 1). The RA is sub-divided into five reaches. Adult salmon monitoring occurred at various locations in the most downstream Reaches (Reach 5 and 4), and salmon were truck transported for release in the most upstream Reach (Reach 1, Figure 1). Sampling was confined to the start of the RA (confluence of the San Joaquin and Merced Rivers) to the furthest downstream in-river impediments (flow-specific) to immigrating fish. From the initiation of sampling through April 11, 2022, it was assumed adult salmonids could immigrate past Van Clief (Eastside Bypass Rock Weir) and potentially the Eastside Bypass Control Structure. Following April 11, 2022 flows in Reach 4B through Reach 5 decreased rapidly. For the remainder of the 2022 sampling season the Van Clief (Kelly Weir) was assumed to be the most upriver extent of adult salmon passage (see Appendix 1A for site-specific pictures). During 2022 adult salmon monitoring, a 10-ft diameter fyke trap was fished in the Eastside Bypass downstream of the control structure through April 20, 2022, and a 4-ft square fyke net was fished downstream of Sack Dam April 10 – 16, 2022. Daily spot checks for fish presence downstream of Sack Dam continued through April 21,

2022. During this period and through the remainder of the spring-run Chinook Salmon Adult Trap and Haul (ATH) sampling season traps were fished upstream of the Merced River confluence at the Hills Ferry Barrier location, in Salt Slough, Mud Slough, mainstem SJR at Van Clief, and downstream of the Bear Creek confluence in the Eastside Bypass at the Van Clief location (Figure 1).

Sampling Duration – The first adult spring-run Chinook Salmon was captured and transported on April 2, 2022. Efforts continued daily through May 15, 2022, when sampling was suspended due to a combination of an extensive period without capturing or observing live salmon (8 days – the last transported salmon occurred May 7, 2022) and likely unsuitable river conditions for spring-run Chinook Salmon (i.e., low flows and elevated temperatures).

2.2 Sampling Equipment and Operation

Steel Fyke Trapping – Where river conditions provide a narrowed and deep channel, steel fyke traps are the preferred sampling approach for capturing immigrating adult salmon in the RA (Figure 2). These traps can be maintained at elevated flows, provide a large area for captured fish to reside after capture, are less likely to contribute to fish entanglement, and are less prone to damage and holes in the cod end (and loss of samples). To adapt to varying site-specific depths, two different size fyke traps are used: 3.1 m diameter x 6.1 m long and 2.4 m diameter x 5.5 m length. Both styles are constructed primarily of chain link fence (5.1 cm mesh; Figure 2) and have a mouth opening (facing downstream) that constricts to a 0.9 m opening permitting fish to swim into the trap, while making it difficult to escape. Traps were deployed and retrieved from their sampling position in the river by a vehicle-mounted winch connected to a main line (0.64-cm steel cable) wrapped around the trap. This process was aided by additional safety guidelines (1.3-cm rope) wrapped around the front and back of the trap and controlled by individuals on the bank. During fish recovery, traps were rolled to a stable location, maintaining enough depth (> 0.3 m) to provide water for trapped fish. Swinging doors permit access into the traps to remove fish using large dip-nets. The fyke traps were generally fished continuously, and were checked, at a minimum, once daily.

Fyke Netting – The nets are constructed of a 1.2 or 1.8 m square entry, followed by a series of three circular compartments, with 2.4 cm square no. 252 knotless nylon mesh. A mesh-constructed partition separates three internal circular compartments that taper to a 25-cm opening, reducing the possibility of fish escaping the net after capture. Wing-walls (1.2 or 1.8 m high) were extended bank to bank in a V-shaped pattern downstream and were used to guide upstream-moving fish into the net (Figure 3). Fyke-nets were anchored with t-posts driven into the substrate. Nets were checked at least once daily for fish, net scour, and damage, were cleaned to prevent debris buildup, were reset and repaired, as necessary.

Panel Weir – Panel weir construction consisted of multiple panel frames overlapping in a V-shaped pattern similar to the above described fyke net wing-walls. Panels were 1.9 m wide x 1.2 m tall with forty-one, 1.8 m tall pickets spaced 2.3 cm apart. Panels funneled down to approximately 0.5 m and opened into a 1.2-m fyke net as described above (Figure 3).

To alert boaters to the presence of sampling gear, marker buoys were placed up- and downstream of all in-river sampling equipment, and flashing amber lights were placed in close proximity to equipment. Water temperature (°C), dissolved oxygen (DO, mg/L) and turbidity (NTU) were measured at each site daily during sampling using a handheld multiparameter instrument. In addition, HOBO TidbiT temperature loggers (Onset; Bourne, MA) were installed at all sampling locations to get a more precise estimate (temperature recorded in 30 min intervals) of site-specific thermal trends.



Figure 1. — Map of the San Joaquin River Restoration Program Restoration Area showing adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring locations in Reaches 5 and 4B. Reaches are denoted in orange-yellow circles and defined by orange dotted lines. During the 2022 season, sampling was concentrated downstream of Eastside Bypass Rock Weir near the Van Clief monitoring location.



Figure 2. — Series of steel fyke traps used to monitor for adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) in the San Joaquin River Restoration Program Restoration Area (Hills Ferry location).



Figure 3. — Panel weir with fyke net used to monitor for adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) at the San Joaquin River Van Clief location in the San Joaquin River Restoration Program Restoration Area.

2.3 Fish Processing, Transport, and Release

Fish Processing – If Chinook Salmon were present in a sample, they were removed prior to any bycatch. Salmon were transferred; one at a time using plastic-coated dip nets, from the trap to a portable insulated Chiller Fish Bag™ (100(L)×40(H)×25(Base) cm) filled at least ½ full of water (river or transport water buffered to within ~4 degrees of on-site temperature). This method allowed fish to remain in water during processing to minimize handling stress. Adult salmon captured were transferred to the fish-haul tank and were processed post-transport at the release site. Salmon processing included collecting a fin-clip from the dorsal or caudal fin for DNA analysis, recording fork (FL) and total length (TL, mm), checking for presence/absence of adipose fin, passive integrated transponder (PIT) tag, and coded wire tag, and making notes on general condition. Identification of fish sex was not attempted because sexually dimorphic characteristics were not distinct in spring-run Chinook Salmon at time of capture, however, fish sex was identified through genetic analysis of tissue samples. Additionally, all salmon released to Reach 1 of the RA were externally marked with a set of uniquely identifiable Dart Tags (Hallprint Fish Tags; Hindmarsh Valley, South Australia) affixed below the dorsal fin. All live fish were intragastrically implanted with an acoustic transmitter (V9, 69 kHz transmitter; VEMCO, Bedford, Nova Scotia) and a 23-mm low frequency half-duplex PIT tag (LF HDX+ PIT tag; Oregon RFID, Portland, Oregon). A balling gun, coated in food-grade glycerin was used to place the acoustic transmitter and PIT tag in the salmon, and all tags were verified active prior to insertion (Appendix C). Acoustic and PIT tags were used to track and identify salmon in Reach 1 following their transport and release, supporting adult over-summer holding, survival, and spawning studies. Bycatch (all non-salmonids) were measured (TL, mm) and released upstream of the nets and traps to minimize likelihood of immediate recapture. Recovered salmon mortalities were processed, sexed, and transferred to a freezer and coded wire tags were recovered by California Department of Fish and Wildlife staff. Additional samples including; eye lenses, egg masses, muscles, scales, and otoliths were recovered and frozen from some individuals for future analyses if deemed important.

Fish Transport - Following capture, spring-run Chinook Salmon were placed in a tank (1.9–3.0 m³) for transport to Reach 1. Transport water was collected from facilities at Friant Dam and was tempered to ~4-5°C below capture temperature using water from the capture location(s). For example, salmon captured in 21°C SJR water would be immediately transferred and transported in 17°C water. Salt was added to the transport tank at approximately 6–10 ppt to alleviate osmotic imbalance and stress-related effects. Oxygen was supplied via a compressed-gas cylinder and regulator in an effort to maintain dissolved oxygen levels ≥ 8 mg/L.

Multiple in-tank agitators were used to assist with oxygenation and water mixing, but primarily to promote degassing of carbon dioxide which can be harmful to fish at elevated levels (Westers 2001). Water quality (water temperature [°C], salinity [ppt], and dissolved oxygen [mg/L]) was collected with a handheld multiparameter instrument before loading fish and immediately prior to fish release. The tank was checked at least once during transport to ensure the oxygen and agitator systems were operational.

Fish Release – Prior to release, water temperature in the transport tank was tempered to within ~2°C of release site temperature using water from the release location at a rate not exceeding ~2°C/hour. From April 2 – May 7, 2022, adult salmon were truck-transported and released at the

Skaggs Bridge Park (Kerman, CA) location in Reach 1. After tempering, fish were processed (see *Fish Processing*), moved to the river in an insulated Chiller Fish Bag™ filled at least ½ full with transport tank water to minimize stress and atmospheric exposure, and permitted time to recover until they were able to swim away under their own volition (Figure 4).

Adult Spring-Run Straying – Monitoring outside of the RA (downstream of the Merced River and SJR confluence) is not conducted by the SJRRP. However, understanding adult SJRRP spring-run Chinook Salmon straying rates is identified in the SJRRP Fisheries Management Plan. Therefore, data on coded wire tagged adult salmon in the Central Valley observed outside of the Restoration Area (available on the Regional Mark Information System Database (www.rmipc.org) were summarized with the assistance of the National Marine Fisheries Service.

3.0 Results and Discussion

Eleven adult spring-run Chinook Salmon were captured (n=10) or recovered (n=1) during 2022 monitoring efforts, resulting in the fourth season of successfully trapping and hauling adult spring-run Chinook Salmon in the RA (2019 n=23; 2020 n=57; 2021 n=93; Figure 5). The 2022 water year was classified as “Normal-Dry”, considerably different than the “Wet” 2019 year, and with less water than 2020 (“Dry”) & 2021 (“Critical High”), indicating adult spring-run salmon successfully immigrated through the SJR and into the RA in less-than-optimal conditions. Based on initial fish capture, the beginning of immigration into the RA during all four ATH seasons (2019, 2020, 2021, and 2022) occurred in early April (Figure 5). Unlike 2019, when it was likely adult salmon were still immigrating through the RA when sampling equipment was removed (Sutphin et al. 2019), weekly capture distribution, elevated late-season temperatures, and low flows suggest the full immigration period was likely encompassed during 2020, 2021, and 2022 monitoring.

After mid-April 2022 flows were reduced to the point where fish were not provided up or downstream passage at the Eastside Bypass Rock weir (Figure A-1). Immediately downstream of this location (Van Clief — see Figure 1) a series of fyke nets (one with a picket weir fish guidance mechanism) and traps spanned the full river width (Figure A—2) providing coverage assumed to allow for capture of most fish moving through this section of the river. Therefore, it is assumed the majority of salmon immigrating through the lower reaches of the RA towards the spawning reach were captured or recovered during 2022 monitoring efforts. Nonetheless, current adult escapement estimates are based solely on enumerating captured adults and gear efficiency estimates that would provide measurement error for such estimates are not currently incorporated in the study design.

Of the 11 adult spring-run Chinook Salmon were captured or recovered during 2022 ATH activities, none died in the capture gear or during truck-transport. Ten salmon were provided a combination of acoustic and PIT tags and released into Reach 1 at Skaggs Bridge Park (Table 1). One carcass was recovered downstream of Sack Dam on April 18, 2022. Adult salmon were implanted with PIT tags and acoustic transmitters prior to release into Reach 1, for the purpose of supporting additional monitoring efforts necessary to track restoration efforts related to salmon population metrics defined in the SJRRP Fisheries Framework (SJRRP 2018).

In total, percent of combined truck-transport induced and capture location mortalities in 2022 (0%) were the lowest since inception of spring-run Trap and Haul (2019 (13%); 2020 (14%); 2021 (11%)). On-site carcass recoveries in 2022 (N = 1, 9%), were higher than the four-year (2019-2022) average of 6% (2019 (N = 0); 2020 (N = 1, 2%); and 2021(N = 8, 9%)). However, these results should be interpreted with caution due to the small sample size of fish in 2022.



Figure 4.— Adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) being released into Reach 1 of the San Joaquin River Restoration Program's Restoration Area.

All 11 tissue samples collected during 2022 adult trap and haul efforts were submitted to the National Oceanic and Atmospheric Administration's Southwest Fisheries Science Center. Genetic analysis classified all individuals as the spring-run phenotype and additionally as Salmon Conservation and Rearing Facility (SCARF) production fish. Through a combination of genetic analysis and field ID, all 11 individuals were identified to sex: 5 female and 6 male (0.8:1 female:male ratio). Sex ratio of adult salmon in 2022 was skewed slightly high towards males (0.8:1, n=11), whereas the three prior years adults were skewed slightly high towards females (2019, 1.6:1, n=18; 2020, 1.1:1, n=40; 2021, 1.1:1, n=79; 2022, 0.8:1, n=11). Trends in sex-specific weekly capture summed across all years of sampling suggest spring-run Chinook Salmon males and females tend to be evenly distributed throughout the immigration season (Figure 6).

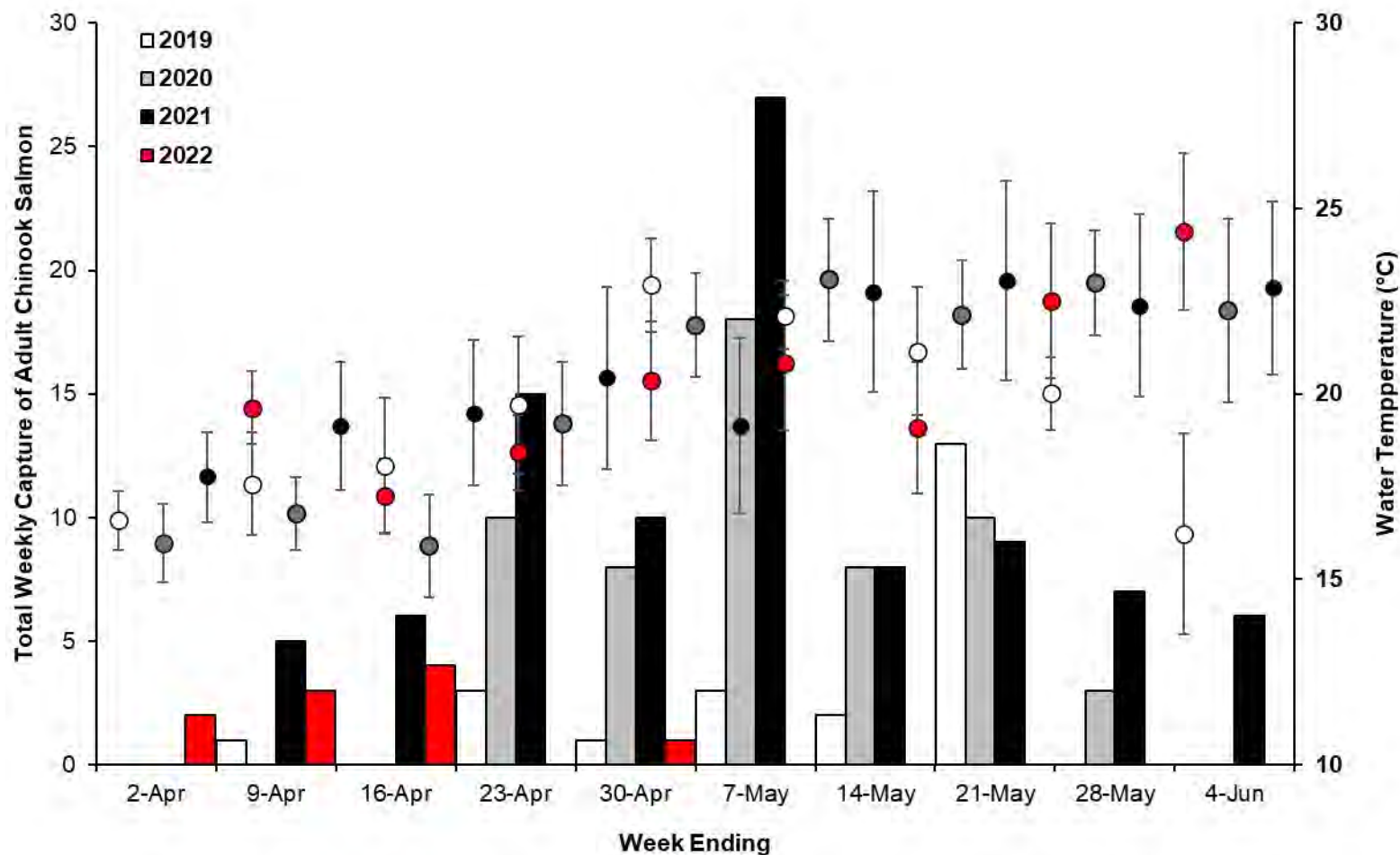


Figure 5. — Weekly capture of adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) during 2019, 2020, 2021, and 2022 monitoring efforts in the San Joaquin River Restoration Program's Restoration Area. Mean 2019 (white circles), 2020 (grey circles), 2021 (black circles) and 2022 (red circles) weekly river temperature at the entrance to the RA (Hills Ferry) as recorded by HOBO TidbiT sensors is reported on the secondary y-axis. Last day of monitoring in 2019, 2020, 2021, and 2022 was May 21, June 1, June 5, and May 15, respectively.

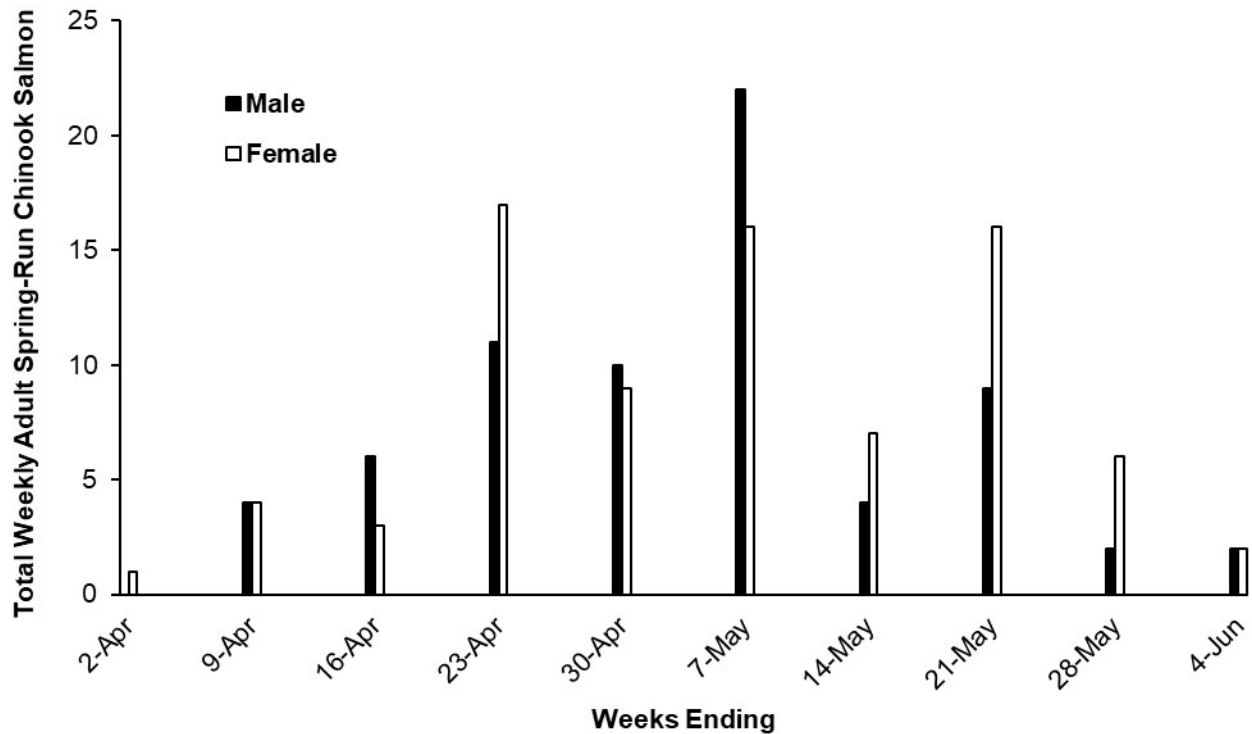


Figure 6. — Total weekly capture of adult male (black; N=70) and female (white; N=81) spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) in the San Joaquin River Restoration Area across 2019, 2020, 2021, and 2022 monitoring seasons (N=151). Fish of unknown sex are excluded.

Size distribution of adult salmon across all years of adult spring-run monitoring is reported in Figure 8. The combination of recovered CWT tagged fish, PIT tagged fish (n = 3), and genetic analysis indicate 36% of adults (n = 4) returning in 2022 were age-3 (brood year 2019) and 64% (n = 7) were age-4 (brood year 2018). Across all years of adult spring-run monitoring age-3 returners constitute the majority (87.7%, n=157) of all fish captured (Figure 9). However, multiple spring-run Chinook Salmon cohorts (multiple age classes) have returned to the RA in each sample season. This is promising for re-establishing a population of spring-run Chinook Salmon in the RA, as one of the key characteristics of a healthy and complex salmon population is the annual return of multiple age classes (Moyle, et al. 1998). Additionally, data recovered from CWT and PIT tags proved multiple juvenile release strategies can be successful, as recovered adults were initially released on different occasions as sub-yearlings (parr and smolts) and larger yearlings. Three (27%) of the 2022 ATH adult spring-run Chinook Salmon were identified as being released as yearlings (CWT 06_05_54), and the remainder as sub-yearlings.

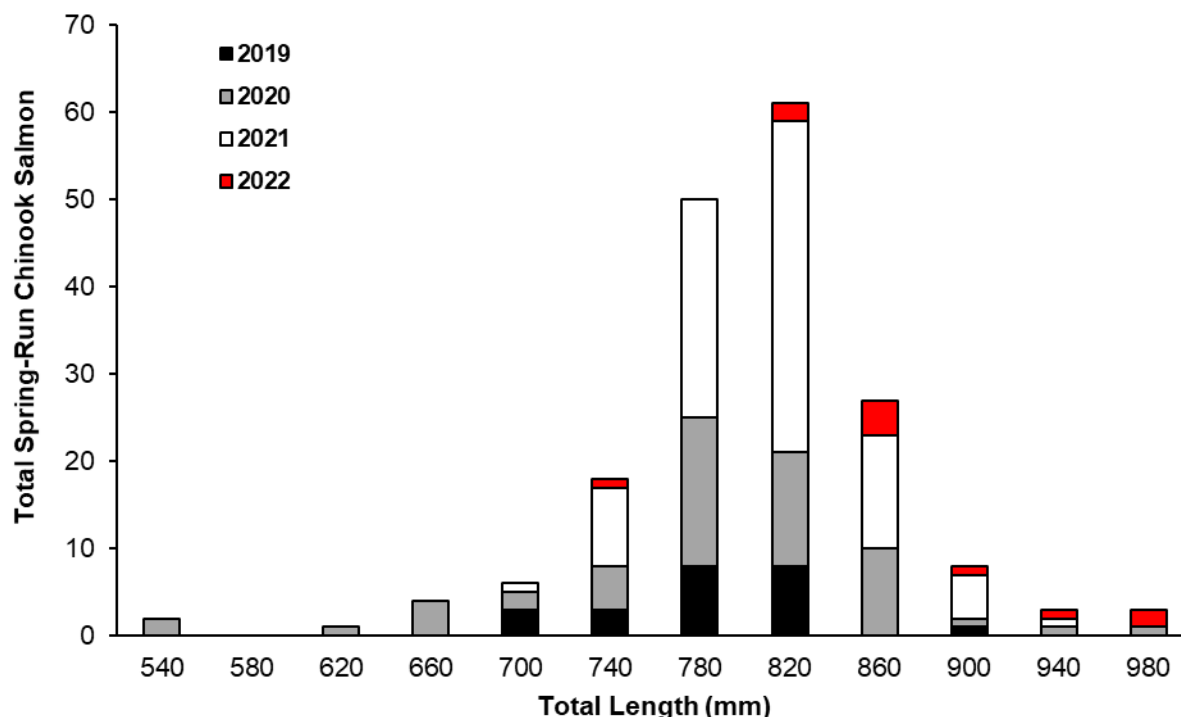


Figure 8. — Size distribution of adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) during 2019, 2020, 2021, and 2022 monitoring activities in the San Joaquin River Restoration Program's Restoration Area (N=185).

Mean daily water temperatures for the majority of the 2022 season, and at most capture locations, were either within the critical range (17-20°C) or above the lethal level (>20°C) for adult Chinook Salmon (EPA Region 10 2003; SJRRP 2018; Figure 8), resulting in the fourth consecutive year of adult spring-run monitoring and trap and haul efforts (Sutphin et al. 2019; Sutphin and Root 2020) with water temperatures above optimal for the majority of the immigration period. In addition to these thermal criteria, the temperature at which adult salmon may delay or suspend upstream movements is reportedly > 21°C (McCullough 1999; McCullough et al. 2001; Richter and Kolmes 2005). Interestingly, across all spring-run Chinook Salmon ATH efforts thus far (2019-22) the majority of fish (83%) have been captured after mean daily in-river water temperatures at the Hills Ferry Barrier exceeded 21°C. Of those individuals captured in these conditions 77% were transported and released successfully in Reach 1 of the RA, and of those individuals, 80% were identified as being in good condition at the time of capture. This does not refute the reported temperatures that could result in a thermal barrier, as individuals could have sought out thermal refugia and made primary movements outside of peak daily thermal period. However, it does emphasize the importance to continue to better understand thermal impacts and establish appropriate thermal criteria for SJRRP spring-run Chinook Salmon.

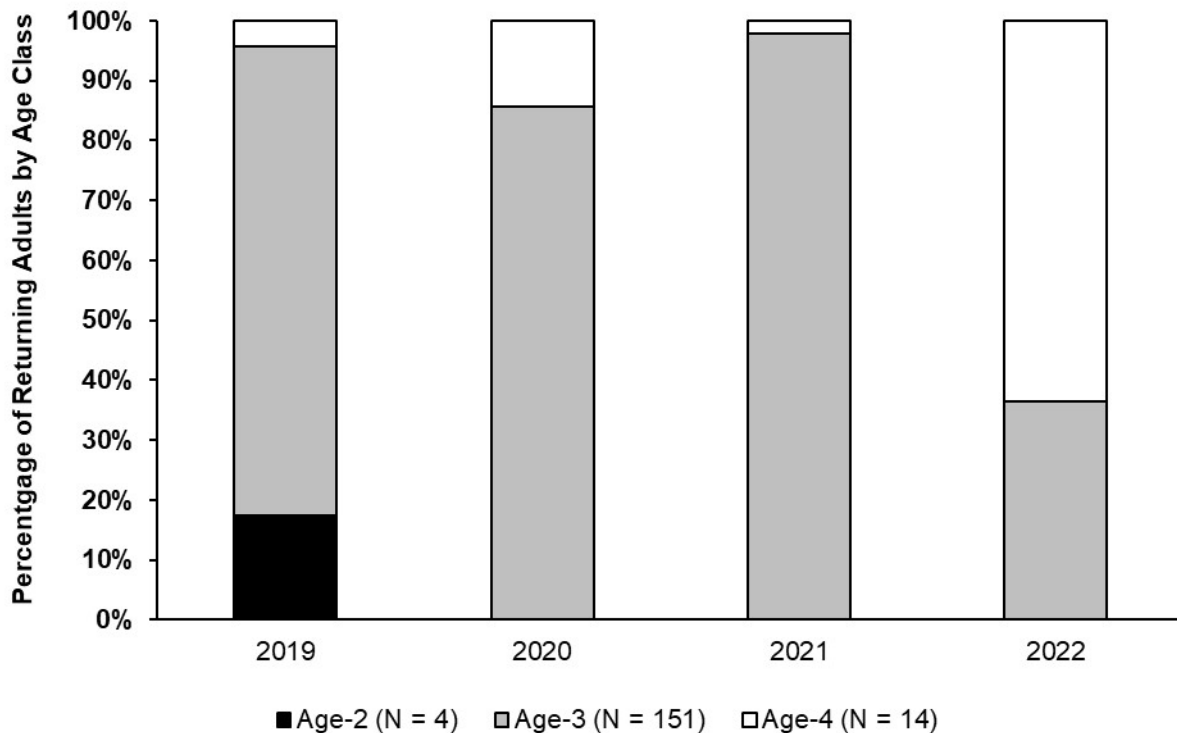


Figure 9. — Age-class distribution of adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) during 2019, 2020, 2021, and 2022 monitoring activities in the San Joaquin River Restoration Program’s Restoration Area.

Across all years of spring-run Chinook Salmon ATH (2019-2022), 156 adult SJRRP salmon have been detected outside the RA as far north as Washington, including 120 individuals that have strayed into Central Valley (CV) systems outside of the SJRRP RA (www.rmpec.org). In 2022, 24 individuals were detected outside of the RA, including 18 in the Sacramento River Basin, and 6 in the San Joaquin River Basin (N=4 Tuolumne and N=2 Stanislaus Rivers). Percentage of SJRRP salmon returning to the RA compared to those straying into all other CV systems in 2019, 2020, 2021, and 2022 were 77%, 88%, 53% and 31%, respectively. These data from systems outside of the RA, and submitted to the Regional Mark Processing Center, are collected opportunistically and not part of a designated study to quantify straying rate or escapement of SJRRP salmon outside of the RA. Similarly, and as mentioned previously, this monitoring effort is also not designed to provide a robust escapement estimate. Nonetheless, this data indicates a portion of SJRRP adult salmon stray from prenatal waters.

Across all sampling locations and methods, 296 non-salmonids (bycatch) were captured during adult spring-run monitoring and rescue efforts (Appendix B). Bycatch was dominated by non-native species, including Common Carp (*Cyprinus carpio*, n = 140), Channel Catfish (*Ictalurus punctatus*, n = 36), Striped Bass (*Morone saxatilis*, n = 33), and Black Bass (*Micropterus spp.*, n = 20). Native non-salmonids captured during this effort were limited to the Sacramento Blackfish (*Orthodon microlepidotus*, n = 4), Sacramento Pikeminnow (*Ptychocheilus grandis*, n = 1), and the Sacramento Sucker (*Catostomus occidentalis*, n = 3).

Table 1. — Capture date, location and method, as well as other recorded characteristics for all spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) captured during 2022 adult spring-run Chinook Salmon monitoring and trap and haul, San Joaquin River, CA.

Fish ID	Capture Date	Capture Location	Method	Fork Length (mm)	Total Length (mm)	Sex	Condition	Acoustic Tag #	Floy Tag #	Prior PIT #	Gastric PIT #	Release Location
SJRRP2022ADULT2038	4/2/2022	Eastside Bypass	Fyke Trap	740	804	F	Fair	17965	2038 2039	No	NA	Skaggs Bridge
SJRRP2022ADULT2040	4/3/2022	Eastside Bypass	Fyke Trap	785	840	M	Good	9063	2040 2041	No	180984844	Skaggs Bridge
SJRRP2022ADULT2042	4/7/2022	Eastside Bypass	Fyke Trap	895	955	M	Good	10239	2042 2043	11125644	180984828	Skaggs Bridge
SJRRP2022ADULT2044	4/10/2022	Eastside Bypass	Fyke Trap	890	955	M	Good	17966	2044 2045	No	180984832	Skaggs Bridge
SJRRP2022ADULT2046	4/12/2022	Eastside Bypass	Fyke Trap	770	832	M	Good	10218	2046 2047	No	180984853	Skaggs Bridge
SJRRP2022ADULT2048	4/12/2022	Eastside Bypass	Fyke Trap	793	852	M	Good	9037	2048 2049	11028021	180984893	Skaggs Bridge
92-7A	4/18/2022	Sack Dam	Hand Net	871	936	F	Carcass	NA	2060	No	NA	NA
SJRRP2022ADULT2050	4/18/2022	Hills Ferry Barrier	Fyke Trap	800	857	F	Good	7022	2050 2051	1123717	180984856	Skaggs Bridge
SJRRP2022ADULT2052	4/18/2022	Van Clief	Fyke Net	741	802	F	Good	7021	2052 2053	No	180984879	Skaggs Bridge
SJRRP2022ADULT2054	4/21/2022	Van Clief	Fyke Net	830	897	F	Good	7020	2054 2055	No	180984862	Skaggs Bridge
SJRRP2022ADULT2056	5/7/2022	Van Clief	Fyke Trap	695	734	M	Fair	7019	2056 2057	No	180984854	Skaggs Bridge

Table 2. — Site-specific monthly water quality (mean $\pm$ 1 standard deviation) during April and May 2022 adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul in the San Joaquin River, CA. Data reported is the mean of point estimates collected at the time of daily site checks.

Location	Month	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (μS/cm)	Turbidity (NTU)
Hills Ferry Barrier	April	17.2 $\pm$ 4.7	8.2 $\pm$ 2.7	1308.6 $\pm$ 623.9	58.1 $\pm$ 7.3
	May	16.9 $\pm$ 1.8	7.4 $\pm$ 0.6	1917.5 $\pm$ 205.7	59.2 $\pm$ 10.0
Mud Slough	April	16.6 $\pm$ 5.6	6.9 $\pm$ 3.1	3403.1 $\pm$ 4140.1	84.5 $\pm$ 16.3
Van Clief (SJR)	April	17.5 $\pm$ 1.4	7.9 $\pm$ 2.1	1499.7 $\pm$ 665.6	19.4 $\pm$ 8.5
	May	17.9 $\pm$ 0.5	6.5 $\pm$ 0.6	1773.0 $\pm$ 42.9	13.0 $\pm$ 2.4
Van Clief (ESBP)	April	17.4 $\pm$ 1.5	8.3 $\pm$ 1.9	609.3 $\pm$ 424.4	60.2 $\pm$ 30.8
	May	17.2 $\pm$ 2.2	6.5 $\pm$ 0.5	1117.1 $\pm$ 80.4	77.6 $\pm$ 10.5
Salt Slough	April	16.0 $\pm$ 5.3	7.3 $\pm$ 3.1	1387.1 $\pm$ 438.9	88.1 $\pm$ 14.1

Table 3. — Date at which Hills Ferry Barrier (2019—22) reached daily average temperatures exceeding 21, 22, and 23°C (SMN, California Data Exchange Center Gauging Station Data, cdec.water.gov).

Year	Water Year Type	> 21°C	> 22°C	> 23°C
2019	Wet	4/19/2019	4/24/2019	4/24/2019
2020	Dry	4/23/2020	4/23/2020	4/23/2020
2021	Critical High	4/18/2021	4/30/2021	4/30/2021
2022	Normal Dry	5/6/2022	5/14/2022	5/15/2022

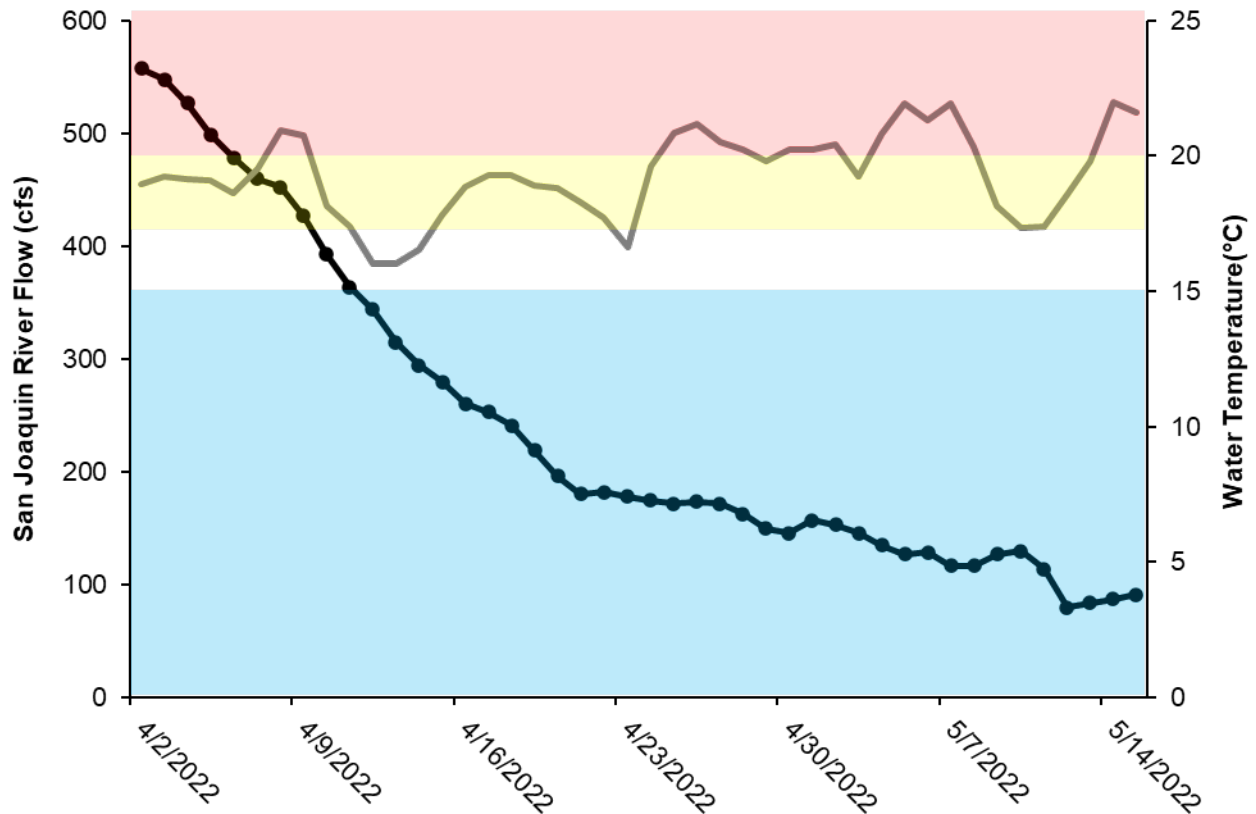


Figure 8. — Mean daily water temperature (°C, grey solid line) and flow (cfs, dotted black line) at the most downstream (Hills Ferry Barrier, HFB) sampling location in Reach 5 of the San Joaquin River Restoration Program (SJRRP) Restoration Area during 2022 adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul (SMN California Data Exchange Center Gauging Station Data, cdec.water.gov). Blue, yellow, and red highlighted areas define migrating adult spring-run Chinook Salmon optimal (< 15°C), critical (17-20°C), and lethal (> 20°C) thresholds as defined in the SJRRP Fisheries Framework (SJRRP 2018).

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5.0 Appendix

5.1 Appendix A — 2022 Spring-Run Chinook Salmon Adult Trap and Haul Site-Specific Pictures



Figure A-1. — Image of Eastside Bypass Rock Weir during 2022 spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) adult trap and haul and monitoring efforts. After April 11, 2022, this location was deemed the first impediment to upstream passage of adult salmonids and no sampling was completed upstream.



Figure A-2. — Sampling equipment (two fyke nets and one fyke trap pictured) immediately downstream of the Eastside Bypass Rock Weir at the Van Cleaf location (see Figure 1 for map) during 2022 San Joaquin River Restoration Program adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul.



Figure A-3. — Sampling equipment (fyke trap) at the Salt Slough location (Freitas Boat Launch; see Figure 1 for map) during 2022 San Joaquin River Restoration Program adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul.



Figure A-4. — Sampling equipment (two fyke nets pictured) at the Hills Ferry Barrier location (see Figure 1 for map) during 2022 San Joaquin River Restoration Program adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul.



Figure A-5. — Sampling equipment (fyke trap) at the Mud Slough location (see Figure 1 for map) during 2022 San Joaquin River Restoration Program adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul.

5.2 Appendix B — Summary of non-salmonids (bycatch)

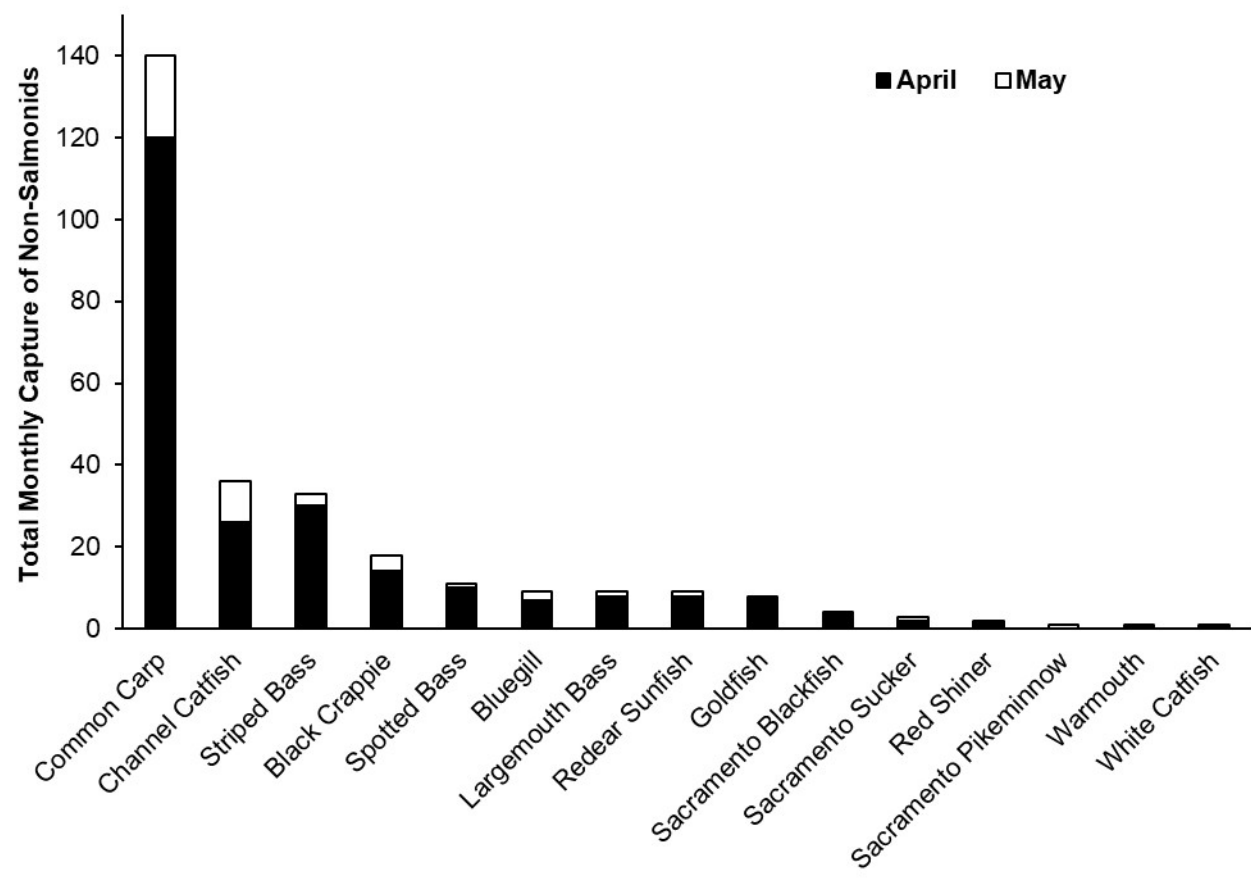


Figure B-1. — Bycatch totals (n= 296) for non-salmonids captured during 2022 adult spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) monitoring and trap and haul.

5.3 Appendix C — Adult Chinook Salmon Post-Transport Processing



Figure 1. — Above images detail Adult Chinook Salmon (*Oncorhynchus tshawytscha*) post-transport processing. From top left to bottom right image: (1) salmon were removed from the haul tank and measured for fork and total length, (2) transferred to a fish bag filled with transport tank water, (3) checked for presence of adipose fin and PIT tag, (4) checked for presence of coded wire tag, (5) provided gastric implant of acoustic and PIT tags (not pictured) and an external dart tag, (6) provided water-to-water transfer to river in fish bag, and (7/8) removed from fish bag in river and permitted time to adjust to in-river conditions until they were able to swim away under their own volition.

