California Department of Fish and Wildlife

North Central Region

Wallace Weir Fish Trapping and Relocation Efforts

2023 – 2024

Report prepared by: Hideaki Shig Kubo

CDFW North Central Region 1701 Nimbus Road, Rancho Cordova, CA 95670

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Purpose

The purpose of this document is to summarize the fish salvage efforts during the 2023-2024 trapping season in the Knights Landing Ridge Cut (KLRC) using the Wallace Weir Fish Collection Facility (Facility). The information in this document is intended to 1) provide historical context describing why a permanent fish collection facility was constructed, 2) document fish salvage efforts in the KLRC at the Facility, 3) show species composition observed in the Facility and 4) compare salvage efforts between the Facility and temporary trapping methods (i.e., fyke traps).

Introduction

Non-natal straying is a natural occurrence for adult salmonids and serves to increase genetic diversity among populations from different watersheds (Quinn, 1984). Anthropogenic impacts to natural waterways such as damming of rivers, water diversions, and the creation of artificial waterways have led to increased straying of adult salmonids in the California Central Valley. Adult salmonids can be attracted to the outflow from man-made canals and become entrained in them. These canals are usually not connected to a river upstream and oftentimes have poor habitat and water quality for adult salmonids and can make them vulnerable to predation and poaching. The entrainment of these fishes leads to a reduction in the adult spawning population. These losses are especially detrimental to Central Valley winter-run and spring-run Chinook Salmon *(Oncorhynchus tshawytscha). S*outhern distinct population segment (sDPS) of Green Sturgeon (*Acipenser medirostris*) have also been rescued as part of these efforts. These species are listed as threatened or endangered under the federal Endangered Species Act (ESA) and state of California Endangered Species Act (CESA). To reduce and prevent entrainment losses, the California Department of Fish and Wildlife (CDFW) has implemented salvage efforts in these man-made canals where salmonids have been observed. Beginning in 2013, CDFW has seasonally installed temporary traps in the Colusa Basin Drainage Canal (CBDC), KLRC, and the eastern toe drain of the Yolo Bypass (Toe drain) for salvaging ESA listed anadromous species (Figure 1). Although these efforts may reduce the impacts from artificially augmented straying, they are not a permanent solution.

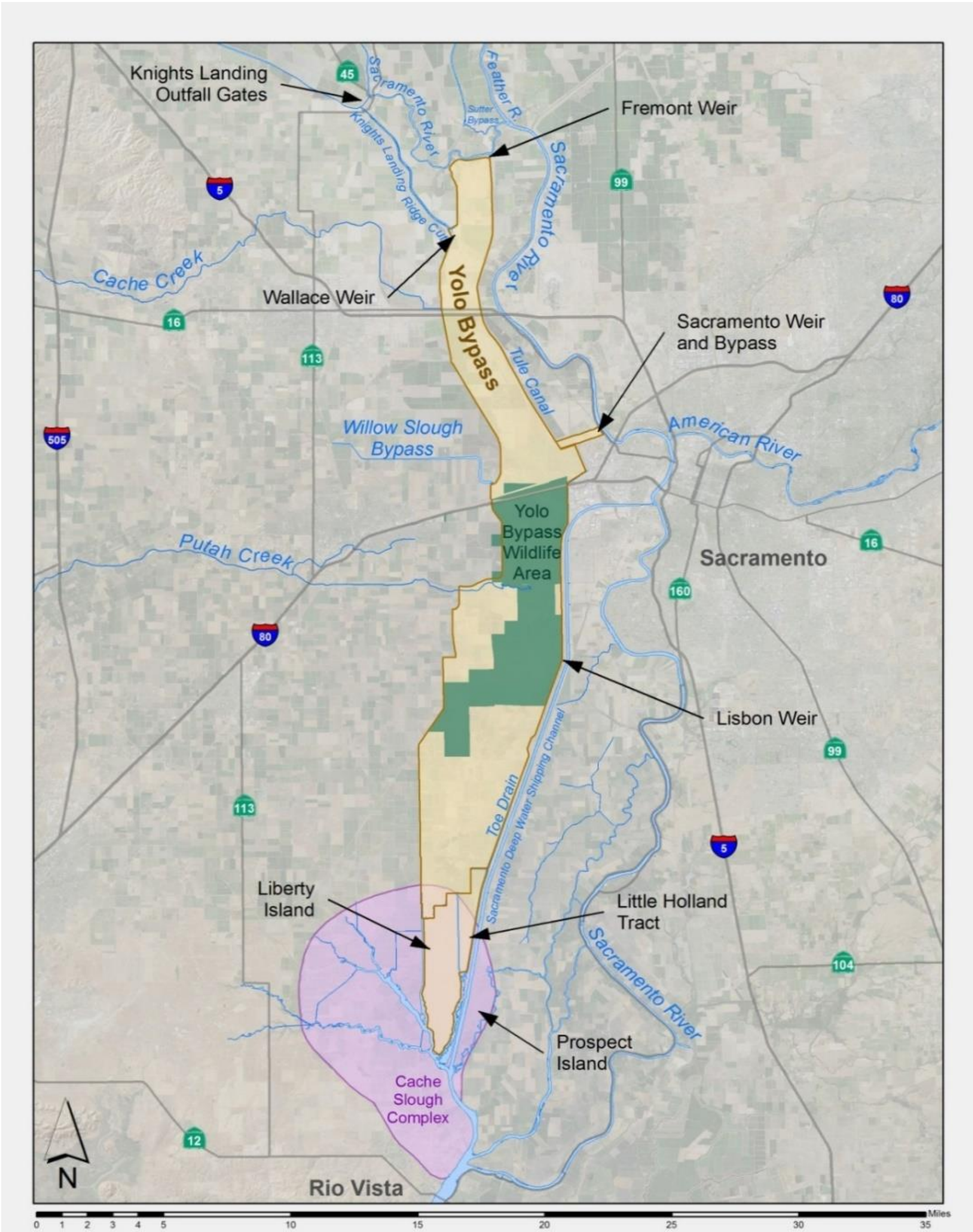

Figure 1. Map of the Yolo Bypass showing the Knights Landing Outfall Gates, Wallace Weir, and the Cache Slough Complex.

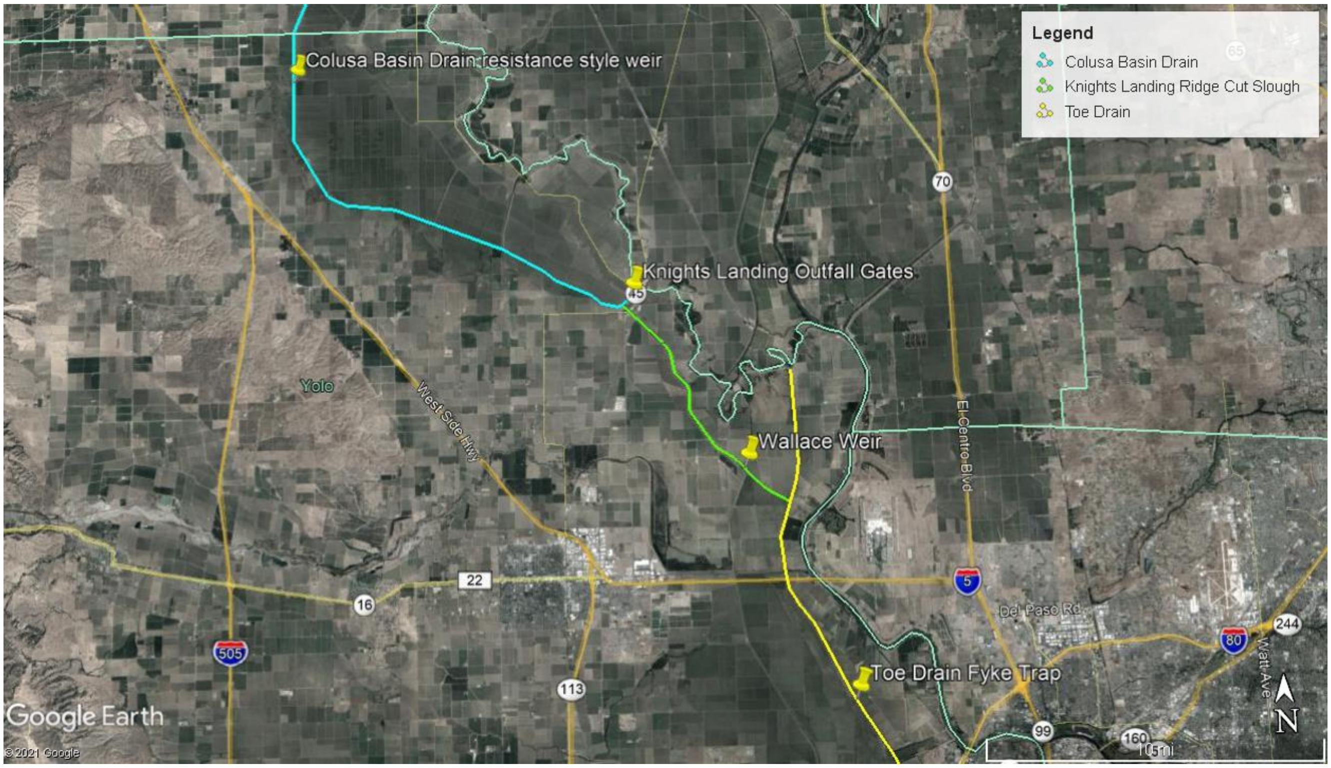

Figure 2. Map showing temporary trap site locations since 2013 in the Colusa Basin Drain (blue), Knights Landing Ridge Cut (green), and the eastern toe drain of the Yolo Bypass (yellow).

Background

During the spring of 2013, CDFW rescued 312 adult Chinook Salmon from the CBDC, a man-made canal that drains approximately one million acres of agricultural land from Glenn, Colusa, and Yolo counties. Genetic and coded wire tag analyses revealed that many of the Chinook Salmon rescued were federally listed winter-run and spring-run origin fish. Following this rescue effort, CDFW implemented trapping efforts upstream of two possible entry points into the CBDC: The Knights Landing Outfall Gates (KLOG) and the Cache Slough Complex (CSC) (Figure 1). Multiple years of trapping in these locations have revealed that much of the salmonid entrainment occurs in the KLRC via the CSC. Conditions allowing for entrainment into the KLRC occur more frequently throughout the year and under a wider range of water years compared to the number of days KLOG is passable in a given year (Gahan et al., 2016). As such, it was deemed necessary to have a more permanent means of salvaging listed salmon and sturgeon from the KLRC. Trapping efforts in the KLRC historically took place approximately 200 meters downstream of an agricultural water control structure known as Wallace Weir (Figure 2). The weir consisted of an earthen berm and manually operated culvert with a wooden slide gate. During high flow events in the KLRC and Yolo Bypass, the weir was subjected to overtopping flows and erosion and needed to be repaired after such events. Similarly, the temporary fyke trap used for salvage operations was also subject to severe damage during these high flow events and needed to be removed beforehand. In an effort between CDFW, California Department of Water Resources (CDWR), and Reclamation District 108 (RD108), the weir was modified to be more robust and include a fish collection facility. Construction on the improved weir and Facility began in the summer of 2016 and was finished in the summer of 2019.

Wallace Weir

Flow Control Structure – The current Wallace Weir flow control structure, or water control structure (WCS), consists of a built-up earthen berm armored with rip rap and six concrete box culverts through which water flows. Obermeyer dams are located on the upstream side of each culvert to regulate flow. On the downstream side of each culvert are bottom hinged metal fish screens that prevent fish from swimming upstream of the weir and further into the KLRC and CBDC. Each of the screens are raised and lowered via an overhead hoist and cable system mounted on the downstream end of the retaining walls. The Obermeyer dams and fish screens are controlled through a user interface housed in a control building on the top of the levee west of the weir. Air compressors that regulate the air pressure in each of the bladder dams are also stored in this control building. The fish screens can be programmed to raise and lower at different time intervals. Lowering of the fish screens can also be triggered by the amount of force being applied to the screens. This is to prevent debris build up which could cause a mechanical failure in the hoist system and result in an uncontrolled drop of the screens.

Fish Collection Facility - The Wallace Weir Fish Collection Facility (Facility) is a concrete structure adjacent to the improved Wallace Weir water control structure, located in the KLRC, approximately 9.7 kilometers southwest of the town of Knights Landing.

The Facility has four major components: the downstream entrance pool, holding pool, Facility intake pool, and energy dissipation basins (Figure 3). The entrance pool is where fish enter the Facility and leads to the holding pool, where fish are collected. The Facility intake pool is at the upstream end of the Facility, where water is diverted from the KLRC into the Facility. A mechanized trash rack is mounted at the intake of the Facility to block large debris from entering. The trash rack is driven by a Rotork actuator. After entering the Facility intake pool, water can be diverted into two energy dissipation basins: one at the upstream end of the holding pool and one running parallel to the west side of the holding pool. Water routed through the western energy dissipation basin drains out to the upstream end of the entrance pool to provide auxiliary attraction or maintenance flow when needed.

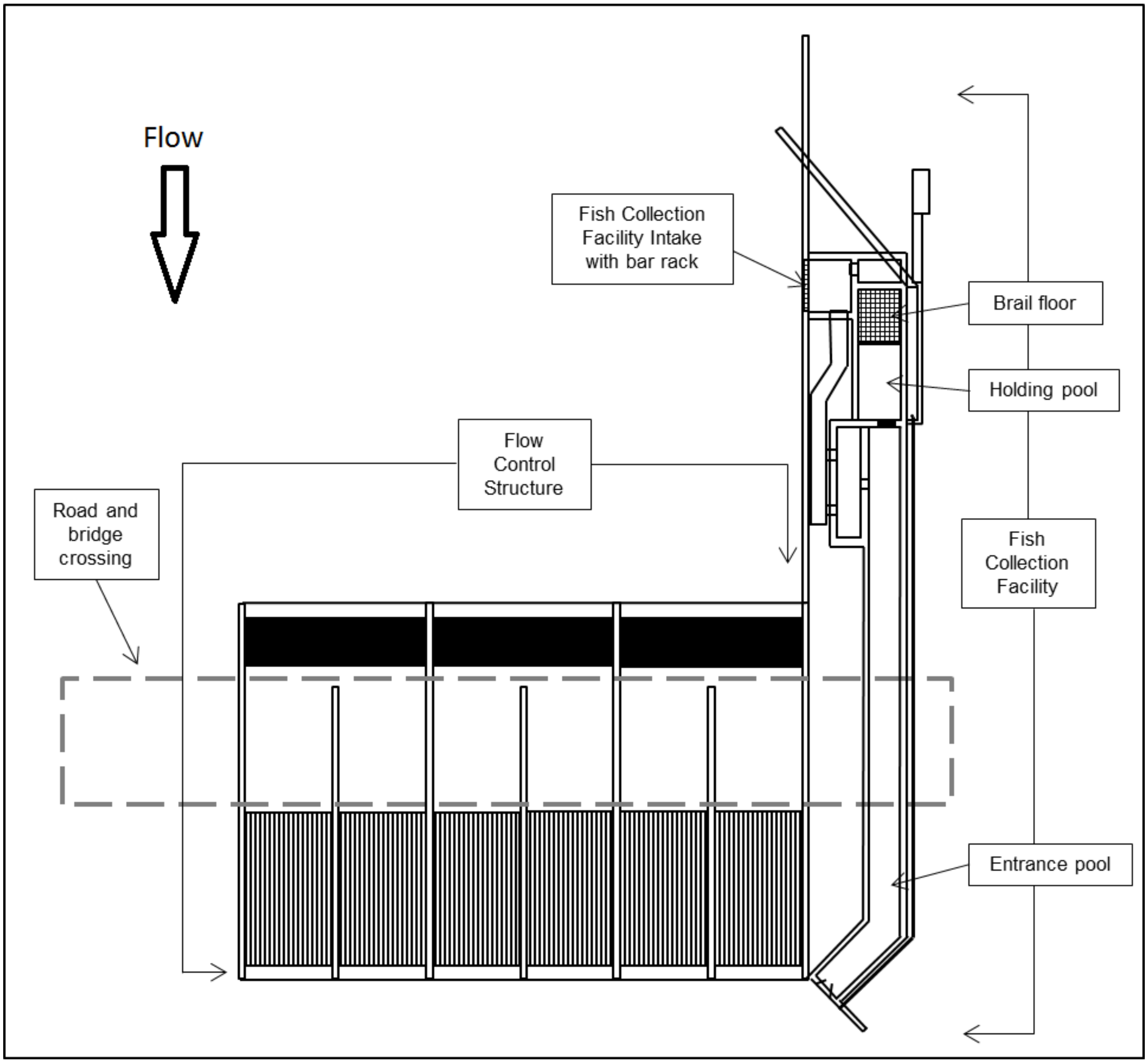

Figure 3. An overhead diagram of the Wallace Weir including the flow control structure and Facility.

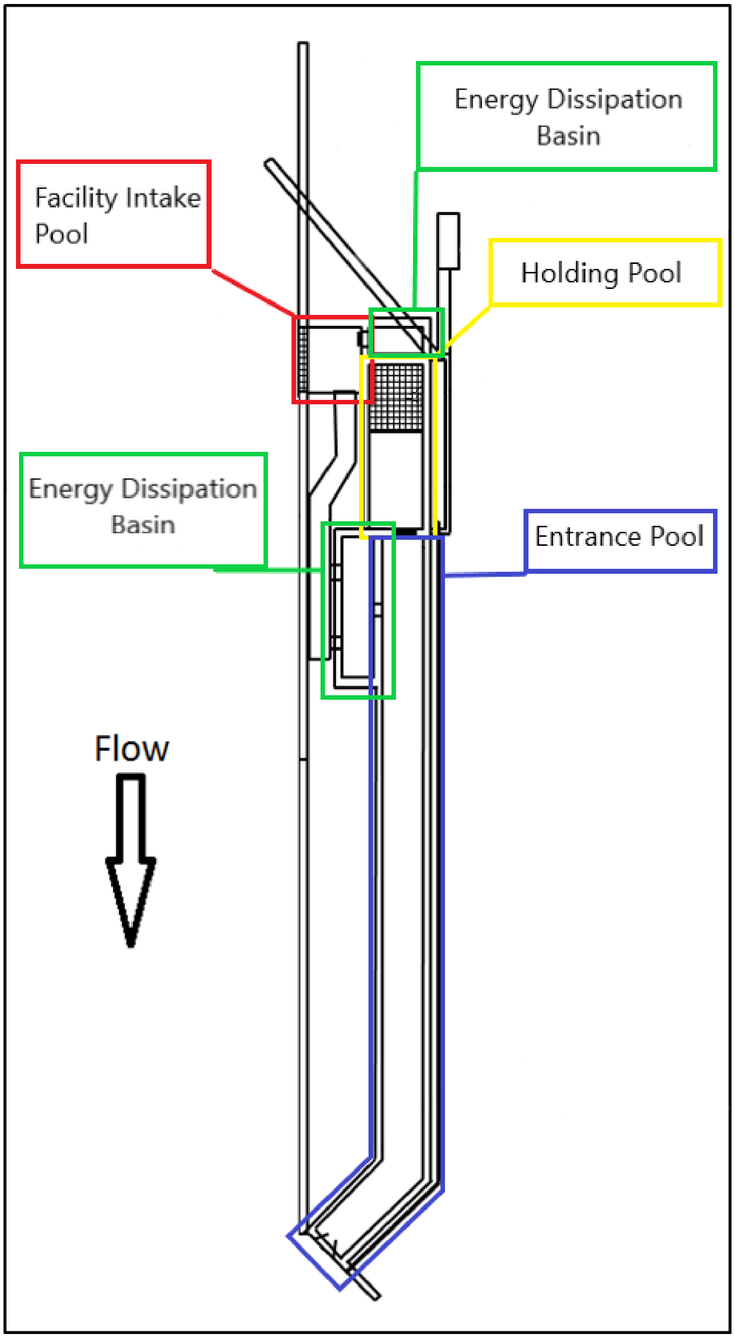

Figure 4. An overhead diagram of the Wallace Weir Fish Collection Facility with the four major components highlighted. The Facility intake pool (red), holding pool (yellow), entrance pool (blue) and the energy dissipation basins (green).

Five gates separate the major components of the Facility: the upstream Waterman gate, western auxiliary Waterman gate, slide gate, screened panel dual leaf holding pool LOPAC gate, and solid panel dual leaf entrance pool LOPAC gate (Figure 4). The upstream Waterman gate regulates flow from the KLRC to the Facility intake pool. The western auxiliary gate regulates flow from the Facility intake pool to the western energy dissipation bay. The slide gate is a stainless-steel plate used to hydraulically isolate the holding pool from the entrance pool. The screened panel dual leaf LOPAC gate opens inwards into the holding pool and prevents fish from swimming back out into the entrance pool. These screened panels allow water to flow through even when closed, but block fish passage. The solid panel dual leaf LOPAC gates are used to adjust the head height of the water inside the Facility as well as to close the Facility.

The holding pool contains two components for collecting fish: a crowder rack and floor brail. The crowder rack is located at the downstream end of the holding pool. The top portion of the crowder rack consists of a platform with four wheels that ride along two metal rails that run lengthwise on the top of the holding pool walls. Metal handlebars mounted to either end of the crowder rack are used to manually push the crowder rack back and forth in the holding pool. The lower part of the crowder rack consists of two screen panels made of metal frames with 1” metal tubing running vertically within the frames. The metal tubes are spaced approximately 1” apart. The bottom of the two panels is raised and lowered mechanically via a chain driven by a Rotork actuator. This allows operators to control when fish pass through or to block them in when crowding in the holding pool occurs. The floor brail is a 10’ by 8’ metal basket consisting of 1” tubing spaced out approximately 1” apart. The floor brail sits in the upstream half of the holding pool and is raised and lowered by two steel threaded stems that are mechanically driven by a Rotork actuator. The floor brail is used to crowd fish towards the surface of the pool when staff are ready to collect fish and transfer them to a workup tub.

The mechanized components of the Facility are operated from a control panel mounted in a cabinet located on the northeast corner of the Facility. The controls are connected to the actuator of the crowder rack, floor brail, and traveling trash rack, providing power and a user interface. The two LOPAC gates and slide gate are operated via corded hand drills. Both LOPAC gates are operated via a drive nut and ball valves. The LOPAC gates open or close depending on which way the drive nut is spun, and which ball valves are opened or closed. The slide gate opens and closes via an operator nut that is rotated with a corded hand drill.

Although the Facility is intended to be operated during a wide range of river and bypass flow conditions, the area it is in is still subject to flooding when the Fremont Weir overtops during high Sacramento River flows. As such, several of the components of the Facility are removable, including: the Rotork actuators for the crowder rack, floor brail, traveling trash rack, and control cabinet. While these components need to be removed before overtopping events, the rest of the Facility can remain in place. This enables trapping to begin quickly after flooding recedes.

The Facility’s flexibility and ability to be operated under a wide range of flow conditions, allow for safer and easier fish salvage operations than using temporary trapping methods.

Methods

Facility Procedures – Salvage operations at the Facility started on November 2, 2023. The dual leaf solid panel LOPAC gates, screened panel LOPAC gates, slide gate, and crowder rack gate were opened with the floor brail in the fully lowered position. While the Facility was fishing, the crowder rack was left on the downstream end of the holding pool with the gate open, allowing fish to swim into the holding pool and access the floor brail. The upstream Waterman gate at the intake pool was fully opened to allow flow through the Facility.

Environmental data were measured and recorded prior to checking the Facility. Water discharge (cubic feet per second) going into the Facility was measured using a Global Water flow probe. Water samples were taken upstream of the Facility for measuring turbidity in Nephelometric Turbidity Units (NTUs). Water temperature (degrees Celsius) and dissolved oxygen (milligrams per liter) were measured in the holding pool using a YSI temperature/dissolved oxygen meter.

Once environmental data were recorded, staff would close the gate on the crowder rack and push the crowder upstream in the holding pool until it became flush with the downstream edge of the floor brail. This concentrated fish in the holding pool above the floor brail. Once the crowder was pushed into position, the floor brail was lifted until the top of the brail was visible. If fish were present, the screened panel LOPAC gate and slide gate were closed, hydraulically sealing the holding pool from the entrance pool, and blocking any other fish from entering the holding pool. After closing the gates, the holding pool was filled with water using the upstream Waterman gate until the water level in the holding pool equalized with the water level in the KLRCS. Then a diesel-powered water pump was used to fill the holding pool, and the floor brail was raised to the surface to allow for easy capture of fish. Fish were netted out using large D-ringed dip nets and salmonids were transferred to a 150-gallon (568 liter) workup tub to be processed. The workup tub was filled halfway with water from the KLRC and approximately 50 milliliters of API stress coat for every 3.8 liters of water. All bycatch were identified to species, enumerated, and returned to the KLRCS, next to the Facility.

Salmonids were identified to species, examined for any external markings or tags (adipose fin clips, Floy tags, etc.), measured to fork length to the nearest 0.5 centimeter, and examined for sex. Two external T-bar anchor tags marked with individual four-digit ID numbers and a contact phone number were implanted into the muscle tissue behind the dorsal fin. A subset of Chinook Salmon was implanted with a HDX23 passive integrated transponder (PIT) tags. All salmonids were sampled for genetics via a fin clip from the upper lobe of the caudal fin. Genetic samples were stored on filter paper and placed inside individually labeled sample envelopes. After salmonids were measured, tagged, and sampled for genetics, they were evaluated for Reflex Action Mortality Predictors (RAMP) (Davis, 2010). RAMP scoring has been used by other researchers as an indicator of stress and predictor of delayed mortality by testing five reflexes:

Tail grab – If the fish responds to handlers grabbing the tail by bursting forward. No response gives a score of 1.

Body flex – If fish attempts to struggle free of handlers grip when held out of the water with both hands around the center of the fish’s body. No struggling gives a score of 1.

Vestibular-ocular response – If the fish's eye rolls to track the handler when rolled on its side out of the water. Eye not rolling to track handler gives a score of 1.

Head complex – If the fish exhibits a regular pattern of operculum ventilation when held above the surface of the water. If the fish is not ventilating or if ventilation is highly irregular, gives a score of 1.

Orientation – If the fish rights itself within 3 seconds after being turned upside down in the water. Fish not rolling over within 3 seconds gives a score of 1.

One point for any of the five reflex tests indicated impairment of that reflex. The higher the score, the more impaired the fish was. Higher scores are also likely to lead to delayed mortality post release. If there was doubt as to whether a reflex was impaired or not, it was assumed that the reflex was impaired, and a point was given. If fish were vigorously struggling to the point where the handler could not control the fish, it was assumed that the fish's reflexes were not impaired and a total RAMP score of 0 was given.

After processing was complete, salmonids were transferred from the workup tub to a trailer mounted 400-gallon transport tank. The transport tank was equipped with two water recirculators and air stones hooked up to oxygen tanks to maintain dissolved oxygen levels while fish were in transit. The transport tanks were filled approximately 3/4 of the way full and API stress coat was added to the water in the same amount as the workup tub. A maximum of 12 fish were loaded into the transport tank at a time. Fish were transported to the Elkhorn Boat Launch on the Sacramento River, approximately 1.8 km downstream of the I-5 bridge. Dissolved oxygen inside the transport tank as well as in the river at the release point were measured and recorded. Temperatures between the transport tank water and river water needed to be within 2 degrees Celsius for fish to be released. If the difference in water temperature was greater than 2 degrees, the water in the transport tank was acclimated to the river water by slowly removing water from the tank and adding river water to the tank. Once the difference between the two water temperatures was less than 2 degrees, the transport tank was backed down the boat ramp into the water and fish were released out of the back of the tank via a slide gate.

Results

Facility Operations - The Facility was fished for 3,017.25 hours during the 2023-2024 season. Trapping operations started on November 2, 2023, and ended on June 6, 2024. The start of the trapping season was delayed due to construction at the Facility. There were 12 days the Facility was not fished due to mechanical issues. The first being with the crowder rack motor. The motor stopped working on January 10, 2024. The cause of the failure was likely due to prolonged exposure to wet weather and internal water damage to electrical components. A temporary set up was installed on January 16 to allow for the crowder rack to be raised and lowered via a cable and pulley system. A steel cable was connected to the top of the crowder rack gate and ran through a pulley mounted to the top of the crowder rack platform. The other end of the cable running out of the pulley to the surface of the Facility was then connected to a truck that could either pull the cable and gate up or lower it back down by slowly moving forward. A safety chain also attached to the top of the crowder rack platform was used to hold the gate up while the trap was being fished. A replacement crowder rack motor was installed on February 21 and operations resumed as normal. The other major mechanical issue was with the slide gate. On April 30, the threading was stripped out of a brass nut inside of the slide gate. A threaded stem runs through this nut and rotates to raise or lower the gate. Since the threading of the nut was stripped out, the slide gate became inoperable. An extra nut was available and immediately replaced. While the nut was being replaced, another component of the slide gate was lost. A square "AWWA" (American Water Works Association) nut was dropped into the entrance channel and lost. This AWWA nut is used as an adapter piece for a drive shaft on the slide gate gear box so that a corded hand drill can be connected to it and spin it one way or another to raise and lower the gate. An extra AWWA nut was available but was not large to fit onto the drive shaft. A larger hole was bored out of the new piece, allowing it to fit onto the drive shaft. The Facility resumed trapping operations on May 6.

Environmental Conditions - Mean weekly flows in the KLRC ranged from 16 cfs (week 19) to 4,252 cfs (week 8). Mean weekly water temperatures at the Facility ranged from 8.7°C (week 1) to 25.3°C (week 22). Mean weekly dissolved oxygen levels in the Facility ranged from 3.4 milligrams per liter (week 1) to 8.0 milligrams per liter (week 44). Mean weekly turbidity ranged from 28.6 NTUs (week 45) to 475.8 NTUs (week 5) (Table 1 and Figure 5).

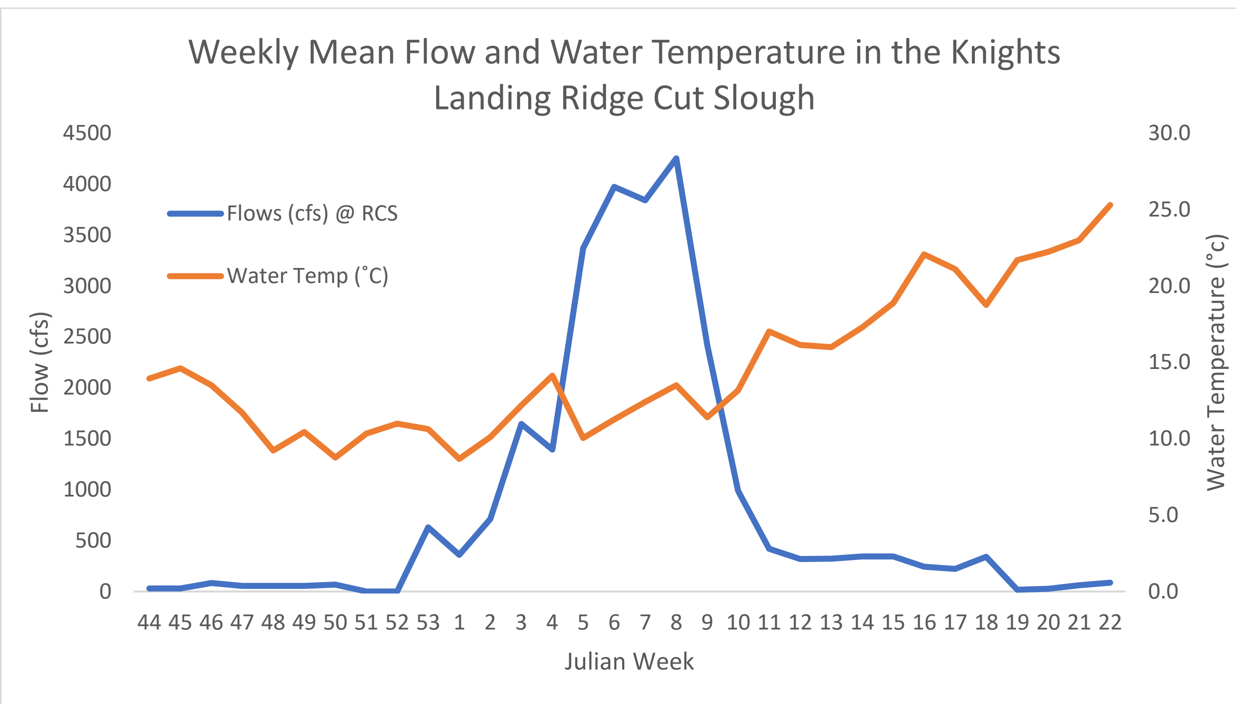

Figure 5. Mean weekly water temperatures (in degrees Celsius) and flow (in cubic feet per second) measured at the Wallace Weir Fish Collection Facility during the sampling season (Julian week). Water flow was reported by CDEC, Ridge Cut Slough (RCS) gauge in cubic feet per second.

Table 1. Weekly average turbidity, dissolved oxygen, flow in the KLRCS, and water temperature measured at the Facility.

Julian Week	Flows (cfs) @ RCS	Water Temp (˚C)	Turbidity (NTU)	D.O. (mg/L)
44	30	13.9	73.8	8.0
45	30	14.6	28.6	7.5
46	84	13.5	43.8	7.7
47	56	11.7	35.8	7.1
48	56	9.2	35.1	6.5
49	56	10.4	50.2	5.5
50	66	8.8	29.4	5.2
51	n/a*	10.3	53.0	3.8
52	n/a*	11.0	56.9	3.5
53	629	10.6	61.2	3.4
1	360	8.7	43.2	3.4
2	711	10.1	67.0	3.5
3	1645	12.2	224.0	3.8
4	1392	14.1	54.9	4.1
5	3368	10.1	475.8	5.1
6	3973	11.3	104.7	4.6
7	3839	12.4	267.3	4.2
8	4252	13.5	65.1	4.1
9	2413	11.4	55.3	5.0
10	989	13.2	62.1	4.8
11	420	17.0	54.3	4.5
12	318	16.1	51.4	4.8
13	323	16.0	66.0	4.9
14	344	17.3	64.0	5.0
15	345	18.9	72.9	6.0
16	244	22.1	69.0	6.3
17	220	21.1	70.6	6.4
18	342	18.8	78.3	6.5
19	16	21.7	42.3	5.0
20	27	22.2	68.4	4.7
21	63	23.0	70.4	5.1
22	86	25.3	53.4	4.0

Fish catch – During the 2023/2024 season, a total of 1,460 fish were captured in the Facility. The catch was comprised of 22 confirmed species, 7 of which were native, along with several unidentified Bullhead and Sunfish species (Table 2).

Table 2. Total catch of all fish species at the Wallace Weir fish collection Facility for the 2023/2024 season. *California native fish species.

Common Name	Scientific Name	Number Caught at WW
Black crappie	*Pomoxis nigromaculatus*	39
Bluegill	*Lepomis macrochirus*	19
Brown bullhead	*Ameiurus nebulosus*	121
Common Carp	*Cyprinus carpio*	295
Channel catfish	*Ictalurus punctatus*	40
*Chinook Salmon	*Oncorhynchus tshawytscha*	801
Goldfish	*Carassius auratus*	10
Green Sunfish	*Lepomis cyanellus*	16
Largemouth Bass	*Micropterus salmoides*	27
Redear sunfish	*Lepomis microlophus*	2
*Sacramento Blackfish	*Orthodon microlepidotus*	3
*Sacramento Pikeminnow	*Ptychocheilus grandis*	3
*Sacramento Splittail	*Pogonichthys macrolepidotus*	15
*Sacramento sucker	*Catostomus occidentalis*	20
Smallmouth Bass	*Micropterus dolomieu*	3
Spotted bass	*Micropterus punctulatus*	5
*Steelhead	*Oncorhynchus mykiss*	7
Striped bass	*Morone saxatilis*	11
UNID Bullhead	*Ameiurus sp.*	2
UNID sunfish	*Lepomis sp.*	6
White Crappie	*Pomoxis annularis*	3
Warmouth	*Lepomis gulosus*	5
White catfish	*Ameiurus catus*	6
*White Sturgeon	*Acipenser transmontanus*	1

Picket weir observations – During the 2023/2024 trapping season, 1,543 fish were observed on the upstream side of the picket weirs of the water control structure. The water control structure was operated from December 2023 to May 2024. The picket weirs were operated during the same time to minimize upstream passage of adult fish. The total count of confirmed fish species observed on the pickets was 22, 6 of which were native. There were also 14 unidentified fish observed on the pickets. Steelhead, Green and White Sturgeon were included in the native fishes observed on the pickets (Table 3). The 6 Green Sturgeon juveniles were all mortalities. Three of the White Sturgeon on the pickets were alive at the time of observation. Two of these fish were juveniles that were recovered and released alive in the Sacramento River. The other White Sturgeon was an adult fish that was flushed downstream of the weir alive (Table 4). All 3 Steelhead observed on the pickets were mortalities (Table 5).

Table 3. Approximate counts of fish observed entrained on the upstream side of the picket weirs of the water control structure throughout the 2023/2024 season. *California native species.

Common name	Scientific name	Total
American Shad	Alosa sapidissima	1
Black Bullhead	Ameiurus melas	1
Black Crappie	Pomoxis nigromaculatus	30
Brown Bullhead	Ameiurus nebulosus	15
Channel Catfish	Ictalurus punctatus	40
Common Carp	Cyprinus carpio	398
Goldfish	Carassius auratus	26
*Green Sturgeon	Acipenser medirostris	7
Green Sunfish	Lepomis cyanellus	7
Largemouth Bass	Micropterus salmoides	18
*Sacramento Pikeminnow	Ptychocheilus grandis	403
*Sacramento Splittail	Pogonichthys macrolepidotus	240
*Sacramento Sucker	Catostomus occidentalis	301
Smallmouth Bass	Micropterus dolomieu	3
Spotted Bass	Micropterus punctulatus	4
*Steelhead	Oncorhynchus mykiss	2
Striped Bass	Morone saxatilis	1
Threadfin Shad	Dorosoma petenense	2
UNID Bullhead	Ameiurus sp.	10
UNID Catfish	Ictalurus sp.	6
UNID Crappie	Pomoxis sp.	6
UNID Sunfish	Lepomis sp.	1
Unknown	???	14
Warmouth	Lepomis gulosus	1
White Catfish	Ameiurus catus	1
White Crappie	Pomoxis annularis	1
*White Sturgeon	Acipenser transmontanus	4

Table 4. Sturgeon recovered from the upstream side of the picket weirs of the water control structure.

Date	Species	Fork length (cm)	Release location	Release time	Mortality (Y/N)	Comments
1/23/2024	Green Sturgeon	32	n/a	n/a	Yes	Recovered on the upstream side of picket weir 3A.
1/24/2024	Green Sturgeon	20.9	n/a	n/a	Yes	Recovered on the upstream side of picket weir 1B.
1/24/2024	Green Sturgeon	n/a	n/a	n/a	Yes	Recovered on the upstream side of picket weir 3A. Only the front half of the body recovered. Predated upon.
2/12/2024	Green Sturgeon	29	n/a	n/a	Yes	Juvenile Green Sturgeon mort recovered on the upstream side of picket weir 2A.
3/21/2024	White Sturgeon	35	Fremont Weir, west side	10:00	No	Recovered on the upstream side of picket weir 3B, alive. Released alive at Fremont Weir.
3/22/2024	White Sturgeon	34.5	n/a	n/a	Yes	Observed on the upstream side of picket weir 3A.
3/22/2024	White Sturgeon	31.5	Fremont Weir, west side	9:30	No	Observed on the upstream side of picket weir 3B.
3/26/2024	Green Sturgeon	30	n/a	n/a	Yes	Recovered on the upstream side of picket weir 3A.
4/5/2024	Green Sturgeon	32	n/a	n/a	Yes	Recovered on the upstream side of picket weir 3B.

Table 5. Steelhead mortalities recovered from the upstream side of the picket weirs of the water control structure.

Date	Species	Fork length (cm)	Ad clip? (Y/N)	Sex (M/F/U)	Comments
3/20/2024	Steelhead	30	No	Female	Recovered on the upstream side of picket weir 3B.
3/21/2024	Steelhead	28	Yes	Female	Recovered on the upstream side of picket weir 3B.
4/24/2024	Steelhead	32	Yes	Unknown	Recovered on the upstream side of picket weir 3B.

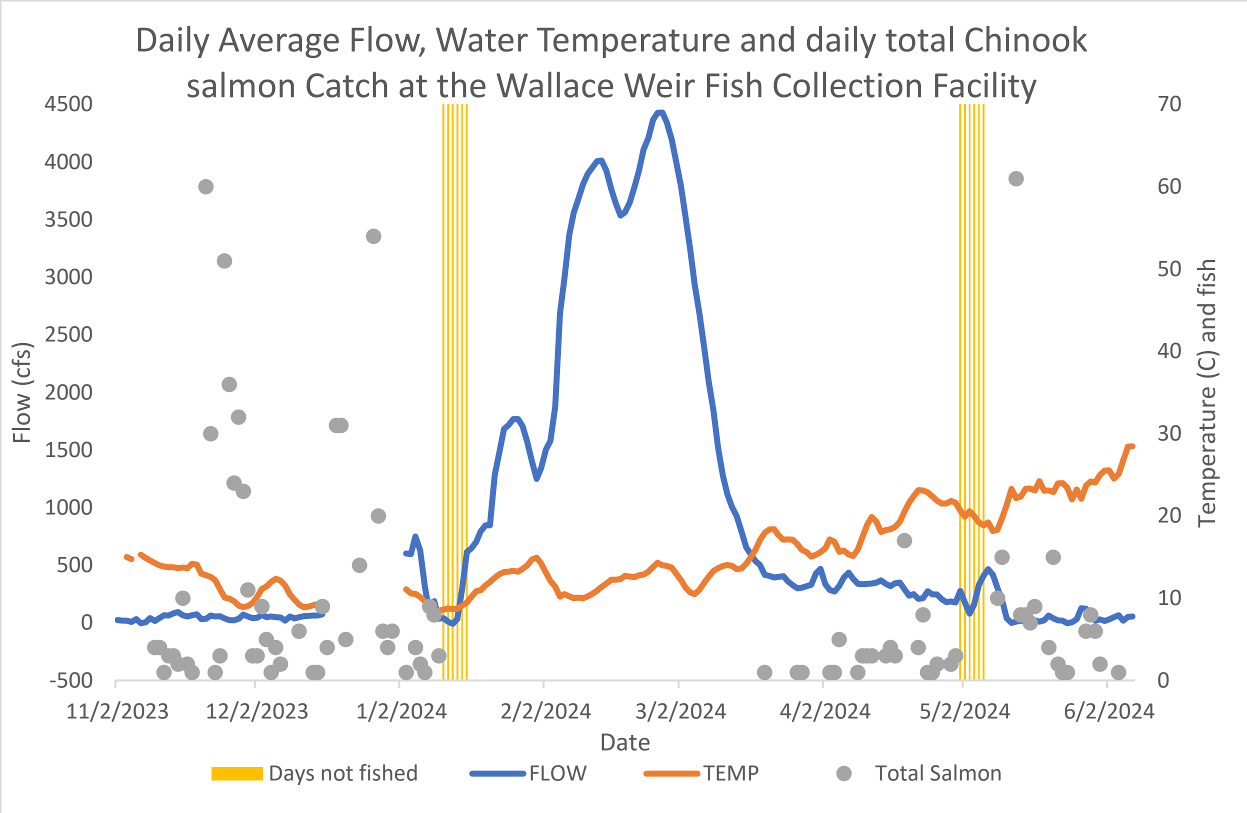

Figure 6. Daily total salmon catch for trapping below Wallace Weir and daily average water temperatures and flows recorded on CDEC on the Ridge Cut Slough at Knights Landing gauge for water year 2023 – 2024. The days that the Facility was not trapping are indicated by yellow vertical bars. River flows reported by CDEC, Ridge Cut Slough at Knights Landing (RCS) and reported in cubic feet per second (cfs).

Salmonid catch – A total of 780 live Chinook Salmon were captured in the Facility during the 2023/2024 season. An additional 9 carcasses were found downstream of the weir and 12 adipose fin clipped salmon were sacrificed for CWT extraction (Table 6). Adipose fin clipped fish made up 44.3% of the total observed Chinook Salmon at or around the Facility. Six of the 21 carcasses found downstream of the weir were heavily predated upon so presence or absence of an adipose fin could not be confirmed. Chinook Salmon catch was bimodally distributed throughout the season, with catch occurring from November to January and March to June. KLRC flows peaked between these two periods (Figure 6). Fishing continued through the spike in canal flows and Fremont weir overtopping since the surface of the Facility remained unflooded. An unusually large number of Chinook Salmon were captured at the Facility during the later half of the season (n=232) with most of these fish being adipose fin clipped (n=215). The average size of the fish captured during this time was 55.8 cm, the largest being 81 cm and the smallest 35.5 cm. Water temperatures at time of capture during this period often exceeded 20 C. Some fish (n=78) were not measured or tagged to reduce handling stress with the higher water temperatures. A total of 7 Steelhead were observed in the Facility, of which 2 were adipose intact and 5 adipose fin clipped. Five of the Steelhead were captured in the Facility in late December, with the other two being captured in April and May.

Table 6. Total catch and recovery of live and dead adipose fin intact, adipose clipped and unknown status of adipose fin Chinook Salmon and Steelhead at and below the Facility between November 2, 2023, and June 7, 2024. *Mortalities found downstream of the Facility in the KLRC. **Adipose fin clipped Chinook Salmon sacrificed for CWT extraction. ***Mortalities found on the picket weirs of the water control structure.

	Chinook Salmon Total	**Chinook Salmon (Adipose Fin Intact)**	**Chinook Salmon (Adipose Fin Clipped)**	**Chinook Salmon (Adipose fin unknown**	**Steelhead Total**	**Steelhead (Adipose Fin Intact)**	**Steelhead (Adipose Fin Clipped)**
Alive	**780**	437	343	0	**7**	2	5
Mortalities	**21**	3*	12**	6*	**3**	0	3***
Grand Total	**801**	**440**	**355**	**6**	**10**	**2**	**8**

Table 7. Catch per Julian week of live Chinook Salmon and mortalities based on adipose fin clip status.

Julian Week	Chinook Salmon (Adipose fin Intact)	Chinook Salmon (Adipose fin Intact) MORT	Chinook Salmon (Adipose fin Clipped)	Chinook Salmon (Adipose fin Clipped) MORT	Chinook Salmon (Adipose fin Unknown) MORT
44	0	0	0	0	0
45	4	0	5	0	0
46	18	0	3	0	0
47	151	0	30	0	0
48	74	0	31	0	0
49	8	1	4	0	2
50	15	2	6	0	1
51	52	0	29	1	3
52	75	0	15	7	0
53	7	0	1	3	0
1	15	0	5	0	0
2	0	0	0	0	0
3	0	0	0	1	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	1	0	0
12	1	0	1	0	0
13	0	0	7	0	0
14	0	0	10	0	0
15	4	0	23	0	0
16	0	0	16	0	0
17	1	0	4	0	0
18	2	0	23	0	0
19	6	0	87	0	0
20	2	0	21	0	0
21	1	0	21	0	0
22	0	0	1	0	0

Sturgeon catch –One juvenile White Sturgeon was captured in the Facility. This fish was tagged with both PIT and acoustic tags and released at the Elkhorn Boat Launch. This same fish was later detected with a portable VR100 acoustic receiver in Grizzly Bay (Table 8).

Table 8. Capture and post release detection information from the juvenile White Sturgeon caught at the Facility.

Capture date	Detection Date	Species	Fork Length (cm)	1st tag type	Tag color/#	2nd tag type	Tag color/#	Release location	Detection Location
4/26/2024	10/4/2024	White Sturgeon	37.5	4 - PIT	3D6.L534925183	2 - Acoustic	V9, Serial # 1541686, A69-1604-10890	Elkhorn Boat Launch	Grizzly Bay

Table 9. Live Steelhead captured and released from the Wallace Weir Fish Collection Facility.

Date	Species	Fork length (cm)	Ad clip? (Y/N)	Sex (M/F/U)	1ST Tag type	Tag #/color	Release location
12/24/2023	Steelhead	42.5	Yes	Unknown	3 - Floy	Gray/4060, 4061	Elkhorn Boat Launch
12/27/2023	Steelhead	45	Yes	Unknown	3 - Floy	Gray/4326, 4325	Elkhorn Boat Launch
12/27/2023	Steelhead	47	No	Unknown	0	-	Elkhorn Boat Launch
12/30/2023	Steelhead	45	No	Unknown	0	-	Elkhorn Boat Launch
12/30/2023	Steelhead	48.5	Yes	Unknown	3 - Floy	Gray/5665, 5664	Elkhorn Boat Launch
4/23/2024	Steelhead	27	Yes	Unknown	3 - Floy	Gray/4629, 4630	Elkhorn Boat Launch
5/16/2024	Steelhead	n/a	Yes	Unknown	0	-	Elkhorn Boat Launch

Post release recoveries – During the 2023/2024 season, a total of 663 Chinook Salmon were Floy tagged, of which, 425 were also PIT tagged. Floy and PIT tags were not applied to all salmonids captured in the Facility due to high stress levels caused by poor water quality conditions for parts of the season (i.e. high water temperatures, low dissolved oxygen). One White Sturgeon was PIT and acoustic tagged (Table 8). Four of the 7 Steelhead captured at the Facility were Floy tagged, none were PIT tagged (Table 9). None of the Steelhead Floy tags have been recovered post release. Floy tags from 18 Chinook Salmon tagged at the Facility were recovered post release from the Facility. The first 6 recoveries reported were from fish captured at the Facility between November and December and were later recovered between November and January. Genetic analysis showed that 5 of these fish were of fall-run origin while one was of late fall-run origin. The 12 other recoveries were from fish captured at the Facility between April and May and later recovered between May and July. All 12 of the recovered fish for this time were of winter-run origin. Most of these 12 recoveries were reported from the Livingston Stone National Fish Hatchery, except for one that was recovered during the Upper Sacramento River winter-run carcass survey. Recoveries were reported from the mainstem Sacramento River, American River, Nimbus Hatchery, Livingston Stone National Fish Hatchery, and the Yuba River. One live recovery was reported from the Central Valley Steelhead fyke trap on the Sacramento River near Verona. This fish was released alive and unspawned (Table 10). PIT tags from 34 Chinook Salmon tagged at the Facility were later detected via PIT arrays maintained by the Central Valley Steelhead Monitoring Program. Detection locations included Battle Creek, Clear Creek, Feather River and the Feather River Hatchery ladder, Mill Creek, Nimbus Hatchery ladder, and the Yuba River (Table 11). Most of the detections were from fish captured in November and December, except for one that was captured in May.

Table 10. Recovery date and location of Floy tagged Chinook Salmon released on the Sacramento River from the Facility during the 2023/2024 season.

Tag & Release Date	Recovery Date	Days at large	Tag color/#	Recovery condition	Recovery location	Disposition	RUN ID	RAMP Score
11/21/2023	11/22/2023	1	Grey/4985, 4984	Live	Sacramento River, near Verona, RM 76.97	Not spawned	FALL	1
11/25/2023	12/5/2023	10	Grey/5209, 5210	Dead	Lower American River, between Sailor Bar and Sunrise Boat Ramp	Spawned	FALL	1
11/27/2023	12/5/2023	8	Grey/4025	Live	Nimbus Fish Hatchery	Culled, not spawned	LATE FALL	0
12/6/2023	12/18/2023	12	Grey/4337	Dead	Lower American River, Nimbus Basin side channel	Spawned	FALL	0
11/25/2023	12/7/2023	12	Grey/5208	Dead	Yuba River, RM 4.4	Spawned	FALL	0
12/27/2023	1/10/2024	14	Grey/5345	Dead	Yub River, RM 4.9	Spawned	FALL	0
4/11/2024	7/10/2024	90	Grey/4554, 4555	Live	Livingston Stone NFH	Unknown	WINTER	1
4/12/2024	7/1/2024	80	Grey/4571, 4570	Live	Livingston Stone NFH	Unknown	WINTER	0
4/12/2024	6/4/2024	53	Grey/4572, 4573	Live	Livingston Stone NFH	Unknown	WINTER	2
4/19/2024	6/4/2024	46	Grey/5033, 5032	Live	Livingston Stone NFH	Unknown	WINTER	0
4/19/2024	5/28/2024	39	Grey/5478, 5477	Live	Livingston Stone NFH	Unknown	WINTER	0
4/19/2024	6/4/2024	46	Grey/5493, 5492	Live	Livingston Stone NFH	Unknown	WINTER	0
4/29/2024	7/10/2024	72	Grey/4621, 4622	Live	Livingston Stone NFH	Unknown	WINTER	0
4/30/2024	6/17/2024	48	Grey/4618, 4617	Live	Livingston Stone NFH	Unknown	WINTER	1
5/10/2024	6/17/2024	38	Grey/4657, 4656	Live	Livingston Stone NFH	Unknown	WINTER	0
5/10/2024	6/12/2024	33	Grey/4660, 4661	Live	Livingston Stone NFH	Unknown	WINTER	0
5/10/2024	7/20/2024	71	Grey/4679, 4680	Dead	Sacramento River, river mile 296.5	Spawned	WINTER	0
5/14/2024	7/1/2024	48	Grey/4683, 4684	Live	Livingston Stone NFH	Unknown	WINTER	1

Table 11. PIT tag detection locations and dates of Chinook Salmon captured and released from the Wallace Weir Fish Collection Facility.

Capture date	PIT tag #s	# of PIT Detections	Location	Detection Dates	RAMP Scores
11/12/2023	982126057397896	1	Yuba River	11/13/2023	0
11/16/2023	982126057397826	267	Battle Creek	12/3/2023	0
11/16/2023	982126057397904	58	Mill Creek	11/20/2023,11/21/2023	1
11/21/2023	982126057397535	1	Clear Creek	11/28/2023	0
11/21/2023	982126057397568	1	Yuba River	11/22/2023	0
11/21/2023	982126057397562	1	Yuba River	11/22/2023	0
11/21/2023	982126057397525	958	Nimbus Hatchery Ladder	11/23/2023-11/26/2023	1
11/21/2023	982126057397540	1	Yuba River	11/22/2023	1
11/21/2023	982126057397560	10	Nimbus Hatchery Ladder	11/28/2023	0
11/22/2023	982126057397584	143	Mill Creek	11/30/23-12/1/23	0
11/25/2023	982126057395444	1	Yuba River	12/2/2023	0
11/25/2023	982126057397477	2710	Nimbus Hatchery Ladder	11/28-11/29/2023	0
11/25/2023	982126057397477	2710	Nimbus Hatchery Ladder	11/28-11/29/2023	0
11/25/2023	982126057397453	1	Yuba River	11/26/2023	1
11/25/2023	982126057397472	1	Yuba River	11/26/2023	0
11/26/2023	982126057397460	5	Feather River Hatchery Ladder	11/30/2023,12/4/2023	0
11/26/2023	982126057397469	5	Feather River Hatchery Ladder	12/2/2023	0
11/26/2023	982126057397515	24	Mill Creek	12/3/2023	0
11/26/2023	982126057397459	1101	Nimbus Hatchery Ladder	11/30/2023,12/2/2023	0
11/26/2023	982126057397495	1	Yuba River	11/27/2023	0
11/26/2023	982126057397502	1	Yuba River	11/27/2023	1
11/27/2023	982126057397457	14	Feather River Hatchery Ladder	12/5/2023	0
11/27/2023	982126057395427	2	Feather River Hatchery Ladder	11/30/2023	0
11/28/2023	982126057397649	1	Yuba River	11/29/2023	0
11/28/2023	982126057397714	1	Yuba River	11/29/2023	0
11/29/2023	982126057397672	3	Feather River Hatchery Ladder	12/4/2023	0
11/29/2023	982126057397699	2	Feather River Hatchery Ladder	12/4/2023	0
11/29/2023	982126057397698	11	Battle Creek	12/10/2023	0
11/29/2023	982126057397684	44	Mill Creek	12/6/2023,12/15/2023	0
11/30/2023	982126057397678	7	Mill Creek	12/5/2023	0
12/1/2023	982126057397688	26	Mill Creek	12/6/2023	0
12/5/2023	982126057397696	9	Feather River Hatchery Ladder	12/7/2023,12/8/2023	0
12/16/2023	982126057397756	12	Mill Creek	12/21/2023,12/22/2023	0
5/10/2024	982091076317374	257	Feather River	5/22/24,5/23/24,6/6/2024	1

Genetics – Results from genetic analysis run on this season's samples showed there were 546 fall-run, 23 late fall-run, 224 winter-run, and 5 spring-run Chinook Salmon (Table 12).

Table 12. Summary of run-assignments based on genetic analysis of Chinook Salmon encountered at and below the Facility.

Run Assignment	Number of fish
Fall	546
Late Fall	23
Winter	224
Spring	5

RAMP Scores – A total of 663 Chinook Salmon captured in the Facility during the 2023/2024 season were evaluated for a RAMP score. The most common RAMP score was 0, and the least common being 4. The most frequently scored reflex was the tail grab (Table 13 and 14). The March through June time period had slightly higher percentages of fish that scored one, three, four and five (Table 15). RAMP scores among fish from each day were averaged together and compared against measured water temperatures and dissolved oxygen levels at the Facility (Figure 7). Spikes in daily average scores occurred in early January and April. Late January is the end of Central Valley fall-run Chinook Salmon run timing and typically more fish are observed in later stages of their life. In April, water temperatures measured at the Facility began to rise after late winter/early spring floods receded. RAMP scores for fish detected or recovered post release were relatively low. Out of the 18 Floy tag recoveries, six of those fish scored above zero, with one of those scored as a two (Table 10). A total of six of the 34 Chinook Salmon with post release PIT tag detections had a RAMP score of one (Table 11).

Table 13. Total count of Reflex Action Mortality Predictor (RAMP) scores of Chinook Salmon caught at and below the Facility.

Total RAMP Score	Number of Fish
0	470
1	124
2	47
3	12
4	1
5	9

Table 14. Total number of times each reflex was scored during a RAMP test.

Tail Grab	Body Flex	VOR	Head Complex	Orientation
128	97	19	15	44

Table 15. Percentage of each RAMP score during the November 2024 to January 2025 month range, and March to June 2025 month range.

	RAMP Scores					
Month Range	**0**	**1**	**2**	**3**	**4**	**5**
Nov. - Jan.	74.14	16.46	7.59	1.81	0.00	0.00
Mar. - Jun.	62.04	29.63	4.63	1.85	0.93	0.93

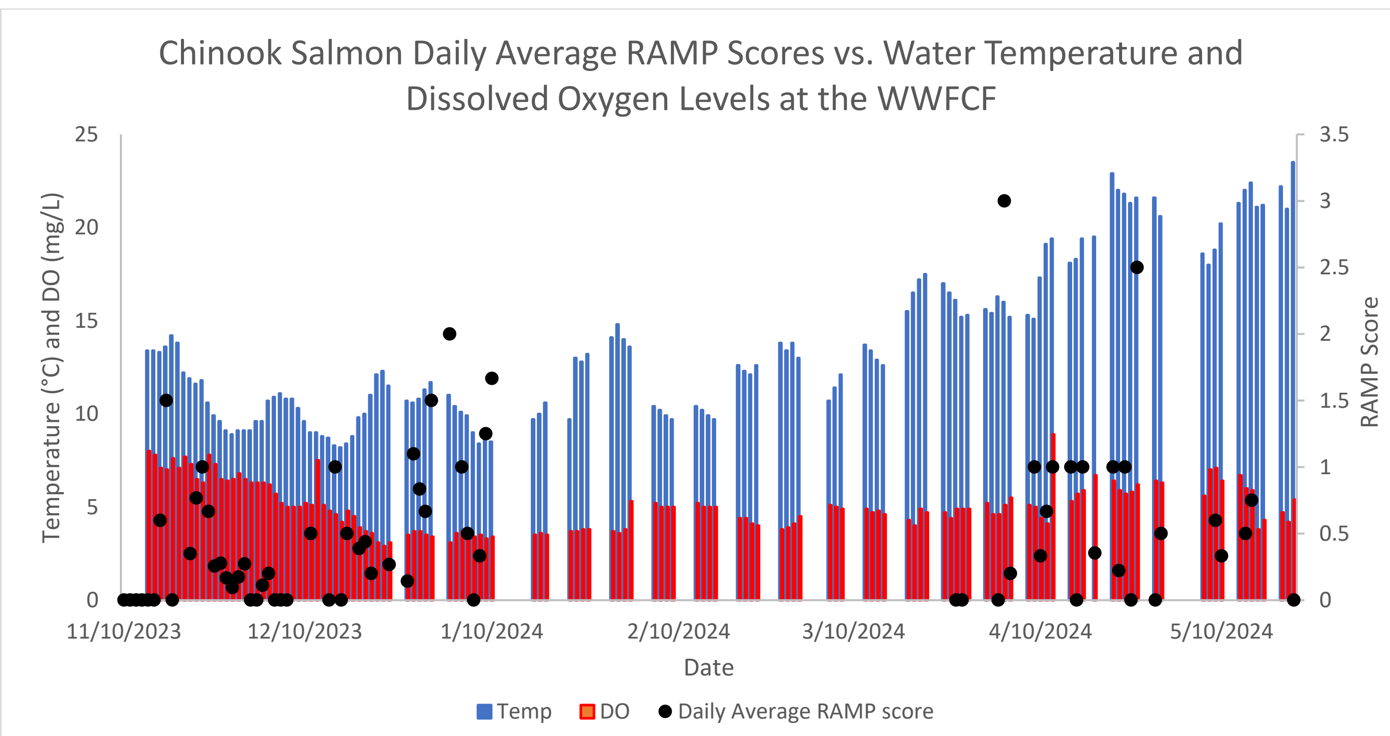

Figure 7. Daily average RAMP scores of Chinook Salmon collected at the Facility plotted against daily measured temperature and dissolved oxygen at the Facility.

Discussion

The 2023-2024 trapping season at the Facility was unusual with regards to quantity, timing, and composition of fish catch. In previous trapping seasons, salmonid catch rates tended to decrease especially during the latter half of the season, following the new year. Catch below Wallace Weir typically consists of mostly fall-run Chinook Salmon, with fewer winter or spring-run being caught in a season. The number of fall-run captured versus winter and spring-run is more consistent with population sizes and hatchery production goals of the respective runs of salmon. Target species encountered at the Facility have mostly been Chinook Salmon and Steelhead, with only one adult White Sturgeon ever recorded prior to this sampling season. The ability to continue trapping through frequent high flow events has likely contributed to the increased observations of fish at the Facility, compared to using a fyke trap. The presence of target species entrained on the upstream side of the picket weirs of the water control structure continues to be an issue during high flow events. Due to the maintenance needs of the water control structure during high flows in the KLRC, there are opportunities for fish to swim upstream of the weir and become entrained on the upstream side of the pickets. However, with the observations of juvenile Green and White Sturgeon on the picket weirs, other means of entrainment upstream of the weir may be possible, such as through upstream diversions in the CBDC (Beccio, 2024). Mechanical issues this season were relatively mild and short lived as fixes for these issues have been developed and a stockpile of replacement parts has been built up.

Both the number of post release Floy tag recoveries and PIT tag detections were the highest this season compared to all other seasons of trapping with the Facility or with temporary traps, though the post-release recovery and detection rates were still relatively low compared to the total number of fish caught. More RAMP testing was carried out to assess the likelihood of post release mortality. Most fish scored zero as well as the ones recovered or detected post-release (Table 10 and 11). Despite the high percentage of fish that scored 0 on the RAMP scoring, there were relatively few post release recoveries reported (52 out of 780). Based on the average daily RAMP scores observed, the spikes in scores seem to coincide with two factors: late season run timing for fall-run Chinook Salmon, and worsening water quality parameters (Figure 7). The spike in RAMP scores in January may be because most of the fish scored were fall-run that were in later stages of their lives and had spent their energy reserves. Dissolved oxygen levels during this time also fell below optimal levels for adult Chinook Salmon, reaching as low as 3 mg/L (WDOE, 2002a). In the spring, water temperatures at the Facility were relatively high, reaching well above 15 degrees Celsius at the beginning of April. By mid-April, temperatures were over 19 degrees Celsius, at which point can be detrimental to Salmonid health (Richter and Kolmes, 2005). Dissolved oxygen levels remained at sub-optimal levels during the spring as well, staying at or below 6 mg/L for most of the time (WDOE, 2002a). The combination of higher water temperatures and lower dissolved oxygen levels likely contributed to the higher percentage of fish with RAMP scores above zero during the spring. Despite a high percentage of fish with low scores or scores of zeros for the whole season, there still may be sub-lethal effects due to exposure to poor water quality and handling stress. With the considerations of low post release recovery rates, it should be noted that the capture and relocation efforts for salmonids should not be considered a long-term solution to stranding and straying in the bypass.

Salmonid catch from November to January of this season was relatively high (n=569) in comparison to previous years of trapping at the Facility. Catch was especially high from March to June (n=231) compared to other years, with this year having the highest salmonid catch for that part of the season. There was consistent flow through the water control structure of the weir for an extended period, longer than what has been observed in other seasons. The large spike in flows followed by the sustained WCS flows likely contributed to the higher salmon catch in the later part of the season. The results of genetic analysis for these fish showed that most were winter-run Chinook Salmon. There were an additional 5 spring-run and 2 fall-run Chinook Salmon captured during this time. Although winter-run catch at the Facility extended late into the season, it was still within their documented historic run timing (Yoshiyama, et al., 1998). This later winter-run migration timing is also not unheard of in the area as capture of winter-run in the KLRC below Wallace Weir has been documented before. During the 2017/18 trapping season, winter-run were observed below Wallace as late as June 2, 2018 (unpublished data). Flows in the bypass and associated canals remained high well into the spring, making for a temporally extended attraction flow into the KLRC. These late high flows also required the operation of the WCS. Chinook Salmon may have been present in the bypass downstream of Wallace in greater numbers earlier in the season than what was observed in the Facility, but due to the relatively low flows from the Facility compared to the WCS, catch remained low. Once flows in the KLRC dropped to below 500 cfs later in March, Chinook Salmon were observed in the Facility (Figure 6). Regardless of the mechanisms affecting winter-run attraction into and through the Yolo Bypass, it is likely that these fish experienced varying levels of delayed upstream migration and some of them spent prolonged periods in poor water quality conditions prior to making it up to Wallace Weir.

The size and adipose fin clip status of the salmon caught during the later part of the season was unusual compared to other years. Most of these fish were adipose fin-clipped (n=214), and were relatively small, with fork lengths ranging from 35.5 cm to 81 cm, and averaging 55 cm. Based on the size of these fish, they appeared to be 2-year-olds. The large percentage of adipose fin clipped fish that made up the catch for this part of the season is unusual for what has been observed at Wallace in the past. This higher percentage of hatchery origin fish based on clip status may be due to hatchery production rates and survival rates of hatchery versus natural origin juvenile winter-run Chinook Salmon for brood year 2022. Both 2021 and 2022 were critically dry water years, likely leading to poor in-river rearing conditions and survival of natural origin juveniles. Thiamine deficiency in natural origin fish is also a likely factor in poor survival during these brood years as this has been an ongoing issue for several years for Chinook Salmon in the Central Valley (NOAA, 2021).

This season's catch of winter-run at the facility between March and June was relatively high compared to previous trapping seasons. Meanwhile, returns on the upper Sacramento River, as reported by the carcass survey, were substantially lower than most seasons. While the possible brood years (2021, 2022) for these fish were critically dry, 2023 was relatively wet, and the Yolo Bypass was inundated during the juvenile winter-run migration timing, as well as before and after Livingston Stone Hatchery releases on the Sacramento River (Figure 8). Due to the timing of the winter-run hatchery releases, it is possible many juveniles were routed through the Yolo Bypass and imprinted on that signal, leading to subsequent straying into the Toe Drain and KLRC.

Figure 8. Hydrograph readings from the Fremont Weir gauge showing two distinct overtopping events that occurred in January and March of 2023. Screenshot taken from CDEC FRE Gauge.

Between March and June, instantaneous water temperatures in the Facility often exceeded 20 degrees Celsius, approaching sub-optimal/detrimental levels for adult Chinook Salmon. Dissolved oxygen levels were also in the sub-optimal to detrimental range (Richter and Kolmes, 2005), reading at approximately 6 mg/L and below for much of the season (Table1). As such, 116 Chinook Salmon were not tagged, of which 77 were also not measured. Although these fish were released alive at the Sacramento River, their fate post release is unknown.

Much like the overall catch of Chinook Salmon at the Facility, post release Floy tag recoveries were bimodally distributed. A cluster of Floy tag recoveries was recorded between November and January, and the other between April and June. All the Floy tag recoveries recorded between April and June were hatchery origin winter-run Chinook Salmon, most of which were recovered at Livingston Stone National Fish Hatchery. Hatchery origin winter-run Chinook Salmon made up most of the catch between March and June.

The distribution of Chinook Salmon catch was bifurcated by high flows in the KLRC coming from the CBDC as well as bypass inundation from Fremont Weir overtopping. While these high flows may attract adult salmonids into the bypass and KLRC, salmonid catch in the Facility is lower than during base flow conditions in the KLRC and when Fremont Weir is not overtopping. The WCS at Wallace can pass a maximum of approximately 4000 cfs, while the Facility can pass 50 cfs. Even without inundation from Fremont Weir, the WCS flows can mask Facility flows, drawing more fish towards the pickets. This pattern in flow and catch has been observed in prior years of trapping at the Facility (Kubo and Kilgour, 2019).

A total of 7 live Steelhead were captured in the Facility, while an additional 3 mortalities were found on the upstream side of the picket weirs. These mortalities were recovered while flows were passing through the WCS, and the picket weirs were flushing at regular intervals to control debris buildup upstream. The Steelhead mortalities likely passed upstream of the screens during a flushing cycle or even earlier in the year when KLRC flows were overtopping the pickets. Though there are not any known measures that can block fish passage during picket weir flushing cycles, frequency and duration of the flushes can be modified to minimize passage opportunities.

Keeping the picket weirs raised as much as possible during high flow events reduces upstream passage opportunities for target species such as Chinook Salmon, Steelhead, and Sturgeon. This also causes entrainment and mortality of fish upstream of the weir that are flushed downstream during these high flow events. There were over 1500 fish counted on the picket weirs during trap checks (Figure 3), but likely many more that were not observed due to picket weir flushing before or after checks and predation. Blocking upstream passage of adult salmonids and sturgeon is a vital function of the picket weirs, but difficult to balance with minimizing debris buildup and entrainment/mortality of downstream moving fish in the canal.

Both juveniles and one adult sturgeon were observed in the Facility and on the picket weirs as well. Most of the juvenile sturgeon observed were mortalities recovered from the upstream side of the picket weirs from February to April. Both Green and White Sturgeon were observed on the pickets. These fish were between 29 and 37.5 cm fork length and estimated to be 1 year old fish. Due to their smaller size, it did not seem possible for them to have swam upstream through the bypass during the earlier high flow events. This behavior also seemed unlikely as sturgeon of this size at this time of the year would be migrating downstream from spawning grounds in the upper reaches of the Sacramento or Feather Rivers. One hypothesis as to how these fish entered the system and ended up on the picket weirs is through diversions on the Sacramento River going into the CBDC upstream of the Facility. The previous year was also a high-water year and there is a possibility that the high river flows may have damaged some of the screened intakes or screens were removed completely for maintenance needs. This has yet to be confirmed as we await responses from irrigation districts within the CBDC.

A live adult White Sturgeon was observed in one of the bays of the WCS on March 20, 2024. This fish was flushed downstream and out of the bay thanks to a coordinated effort between CDFW and RD108 staff. Since this fish was not captured, an exact measurement could not be taken, nor tags implanted. The length of this fish was estimated to be approximately 7 ft. This fish was likely large enough to overcome flows out of the WCS and swim upstream of the weir, or at least upstream of the pickets. Like other observations at Wallace this season, the occurrence of this fish in the WCS bay was unprecedented. Fortunately, a successful strategy was employed to safely flush the fish off the screens, downstream of the trap. This is a valuable tool to have for potential future occurrences.

The unprecedented nature of this season's catch has provided insight into the potential magnitude of winter and spring-run presence during a high-water year. The late season catch has demonstrated how conditions on site are not always conducive to survival of target species post release, as many of the fish captured in the latter half of the season were not tagged or measured to reduce handling stress. Though there were more post release Floy tag recoveries and PIT detections than any other season, those recoveries and detections are still a small portion of the overall tagged catch. The observations of juvenile sturgeon upstream of the picket weirs has warranted further investigation into the status of intake screens for upstream diversions. Additionally, the presence of juvenile Steelhead and an adult White Sturgeon on the upstream side of the picket weirs highlights the need to adjust picket weir operations and constantly adapt to changing flow conditions.

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