California Department of Fish and Wildlife

North Central Region

Wallace Weir Fish Trapping and Relocation Efforts

2019 – 2020

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Purpose

The purpose of this document is to summarize the fish salvage efforts during the pilot 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 as to why a permanent fish collection facility was constructed, 2) document the first season of fish salvage efforts in the KLRC using the facility, 3) show species composition observed in the facility and 4) compare salvage efforts using the facility and temporary trapping methods (i.e., fyke traps).

Introduction

Straying from non-natal stream is a natural occurrence for adult salmonids and serves to increase genetic diversity among populations of different watersheds. 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 become entrained in man-made canals that are not connected to a river upstream and have poor water quality. This entrainment in unsuitable habitat leads to a loss to the spawning population. These losses to the spawning population are especially severe in the cases of species listed as threatened or endangered under the federal Endangered Species Act (ESA) and state of California Endangered Species Act (CESA) such as Central Valley winter and spring-run Chinook salmon *(Oncorhynchus tshawytscha)*. To reduce and prevent such losses, the California Department of Fish and Wildlife (CDFW) has implemented salvage efforts in man-made drainages where salmonids tend to stray on an annual basis. Since 2013, CDFW has installed temporary traps in the Colusa Basin Drainage Canal (CBDC), the KLRC and the eastern toe drain of the Yolo Bypass (Toe drain) for salvaging ESA listed anadromous species (Figure 1). Although these efforts may minimize the impact that artificially augmented straying can have, they are not permanent solutions.

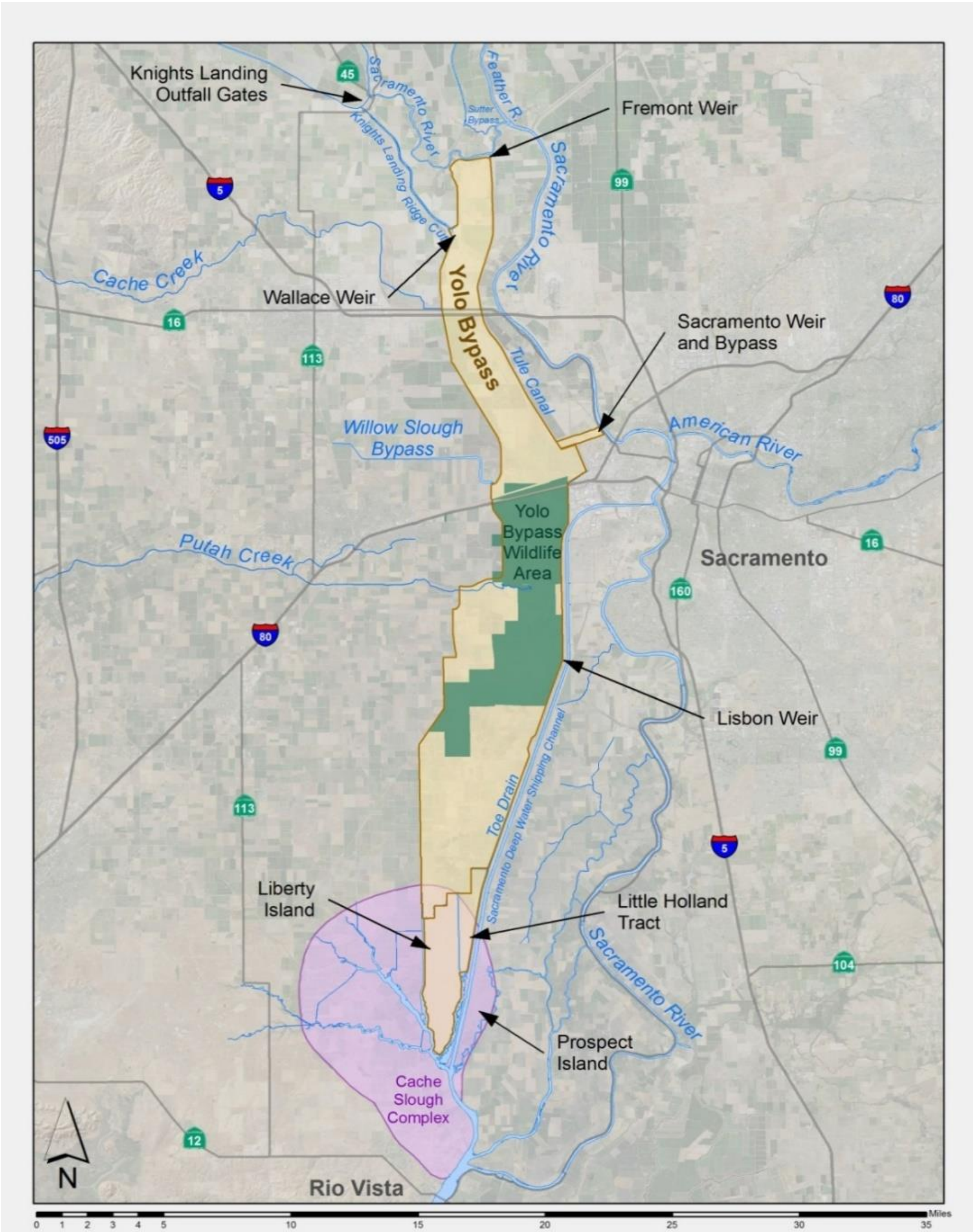

Figure 1. Map of the Yolo Bypass showing the Knights Landing Outfall Gates, Wallace Weir, and the Cache Slough Complex.

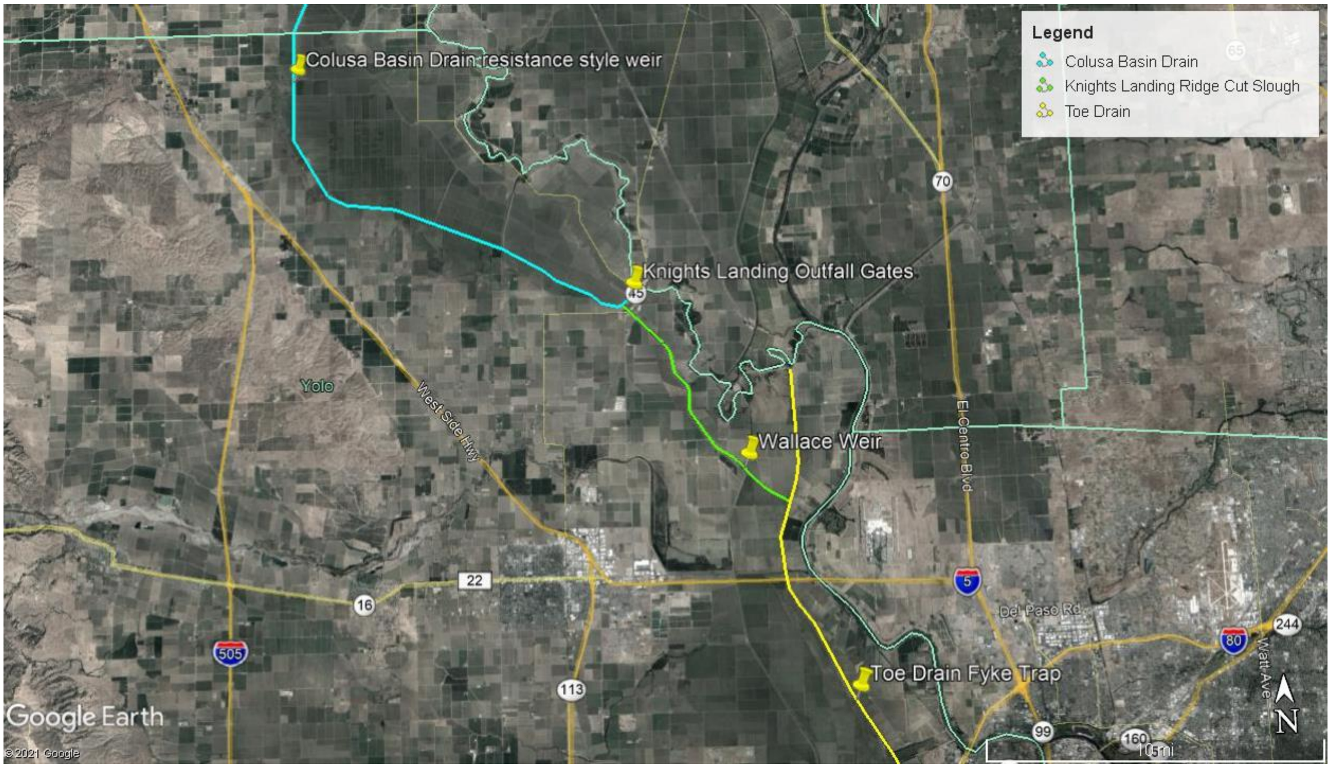

Figure 2. A map showing temporary trap sites set up by CDFW since 2013 in the Colusa Basin Drain (blue), the Knights Landing Ridge Cut (green) and the eastern toe drain of the Yolo Bypass (yellow).

Background

During the spring of 2013, the California Department of Fish and Wildlife (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. After genetic analysis and coded wire tag readings, it was determined that many of the Chinook salmon rescued were winter and spring-run origin fish, both federally listed as endangered and threatened, respectively. Following this rescue effort, CDFW has implemented temporary trapping efforts upstream of two possible entry points into the CBD: The Knights Landing Outfall Gates (KLOG) and the Cache Slough Complex (CSC) (Figure 1). Since the start of the temporary trapping efforts in the two locations, it has been determined that much of the entrainment of salmonids occurs in the KLRCS via the CSC. Conditions allowing for entrainment into the KLRCS 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 salmonids and acipenserids from the KLRC. Trapping efforts in the KLRCS were taking 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 subject to flows overtopping and erosion and needed to be reconstructed after such events. Similarly, the temporary fyke trap used for salvage operations downstream 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 collection 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 consists of a built up earthen berm armored with rip rap and six concrete box culverts through which water flows. On the upstream side of each culvert are Obermeyer dams which regulate flow through each culvert. 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 via an overhead hoist and cable system mounted on the downstream end of the retaining walls separating each of the culverts. The Obermeyer dams and fish screens can be 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 ensure that the screens are not clogged with debris and potentially cause a mechanical failure in the hoist system resulting 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's major components are separated by a series of gates.

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 to the facility. A mechanized traveling trash rack is mounted at the intake for the facility to block large debris from entering the facility. The trash rack is driven by a Rotork actuator. After entering the facility intake pool, water can be diverted into two energy dissipation basins within the facility: 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.

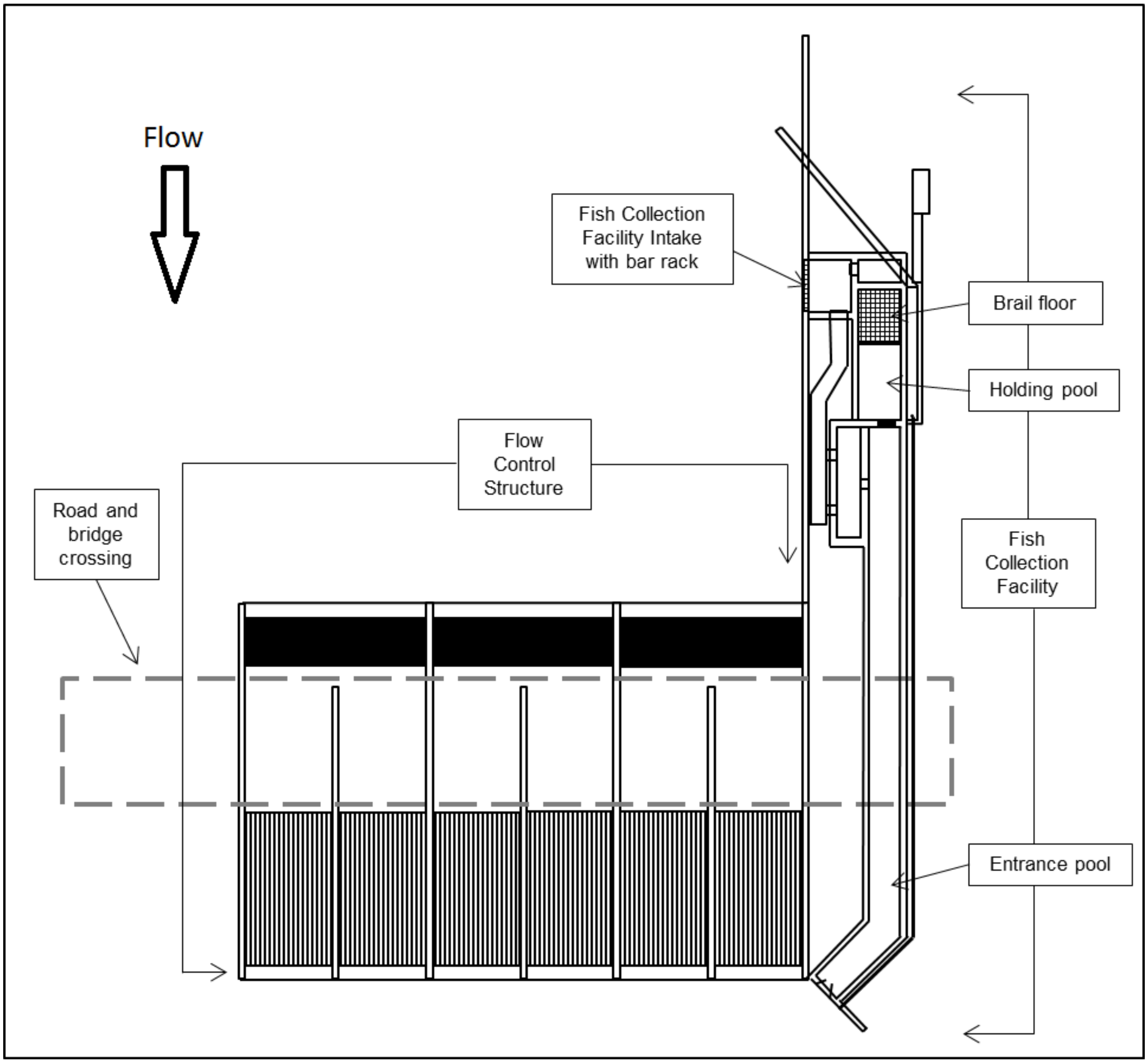

Figure 3. An overhead diagram of the new Wallace Weir including the flow control structure and fish collection facility.

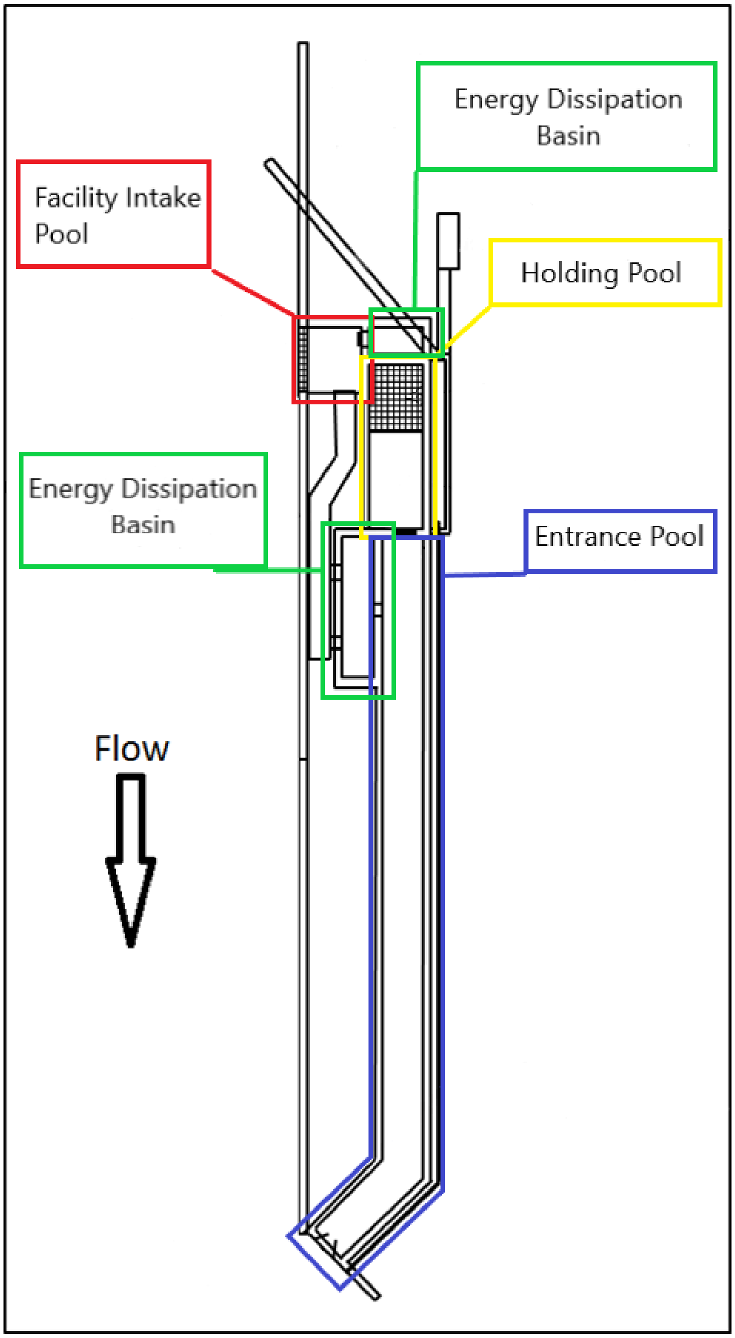

Figure 4. An overhead diagram of the Wallace Weir Fish Collection Facility with the four major components highlighted. The facility intake pool (red), holding pool (yellow), entrance pool (blue) and the energy dissipation basins (green).

Five gates separate the major components of the collection 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 going 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. Since these panels are screened, they allow water to flow through even when closed, but block fish passage. The solid panel dual leaf lopac gates can be used to slightly adjust the head height of the water inside the facility as well as close the facility.

The holding pool houses two components for collecting fish: a crowder rack and floor brail. The crowder rack is in 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 and are spaced approximately 1" apart. The bottom of the two panels can be raised and lowered mechanically via a chain driven by a Rotork actuator. This allows for fish to either pass through or be blocked 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 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 from the holding pool and transfer them to a workup tub.

The mechanized components of the collection facility are operated through a control panel mounted in a cabinet located on the northeast corner of the collection 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 will either open or close depending on which way the drive nut is spun with the drill and which ball valves are opened or closed. The slide gate opens and closes via an operator nut that is spun 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 as is and allows for trapping to begin quickly after flooding stops. This flexibility and ability to accommodate a wide range of flow conditions makes the facility a safer and easier method for salvaging fish in the KLRCS than using temporary trapping methods.

Methods

North Delta Flow Action Study - From August 26 to September 21, 2019, DWR conducted a pulse flow experiment. The purpose of this experiment was to see if a continuous pulse flow from the CBD could increase primary productivity in the CSC thus increasing food availability for

Delta Smelt as part of the Delta Smelt Resiliency Plan. Water drained from rice fields into the CBD was routed through the KLRC, through WW into the eastern toe drain of the Yolo Bypass and subsequently into the CSC. The Knights Landing Outfall Gates, a structure that regulates flow from the CBD into the Sacramento River, remained closed during this pulse flow to maximize the amount of water diverted into the KLRCS. It was expected that this pulse flow would attract salmonids into KLRCS. As such, the facility began operation in conjunction with the flow pulse to capture any salmonids attracted into the KLRCS (Davis, et al., 2019).

Facility Procedures - Salvage operations in the KLRCS using the facility started on August 26, 2019. 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 would be 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 of the facility was fully opened to allow flow through the facility.

Environmental data were measured and recorded prior to fishing the facility. Water velocity going into the facility was measured in feet per second using a Global Water flow probe. Water samples were taken upstream of the facility for measuring turbidity, measured in NTU's. Water temperature and dissolved oxygen levels were measured in the holding pool using an In-situ water temperature/dissolved oxygen meter. Water temperature was measured in Celsius and dissolved oxygen was measured in percent saturation.

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 to concentrate 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, along with any fish present. 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 to within a foot or less below the surface elevation of the top of the holding pool walls, 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) tag. 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 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 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 and 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 Fahrenheit for fish to be released. If the difference in water temperature between the two was greater than 2 degrees, the water in the transport tank would be 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 below 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 4,266 hours during the 2019-2020 season. Trapping operations started on August 26, 2019 and ended on June 2, 2020. Due to mechanical failures on the slide gate and crowder rack, salvage operations using the facility stopped temporarily from October 11 until December 9, 2019 and February 2 until February 5, 2020. Six beach seining efforts were conducted downstream of the facility. A 10’ by 91’ beach seine with 1.5” mesh was used. Seine hauls started approximately 300’ downstream of the facility and ended at the facility. Beach seining efforts took place on October 18, 24, 28 and November 4, 8, and 14, 2019 (Figure 6). A temporary fyke trap was installed downstream of the facility on December 4, 2019 and taken out December 6, 2019. It was only fished for 19 hours due to forecasted high flows in the KLRC.

Environmental Conditions - Mean weekly flows in the KLRC ranged from -8 cfs (week 42) to 706 cfs (week 36) (Figure 5 and Table 1). Mean weekly water temperatures at the facility ranged from 8.9 °C (week 1) to 26.2 °C (week 23) (Figure 5 and Table 1). Mean weekly dissolved oxygen levels in the facility ranged from 29.13 percent (week 47) to 82.53 percent (week 44) (Table 1). Mean weekly turbidity ranged from 2.00 NTUs (week 45) to 30.80 NTUs (week 37) (Table 1).

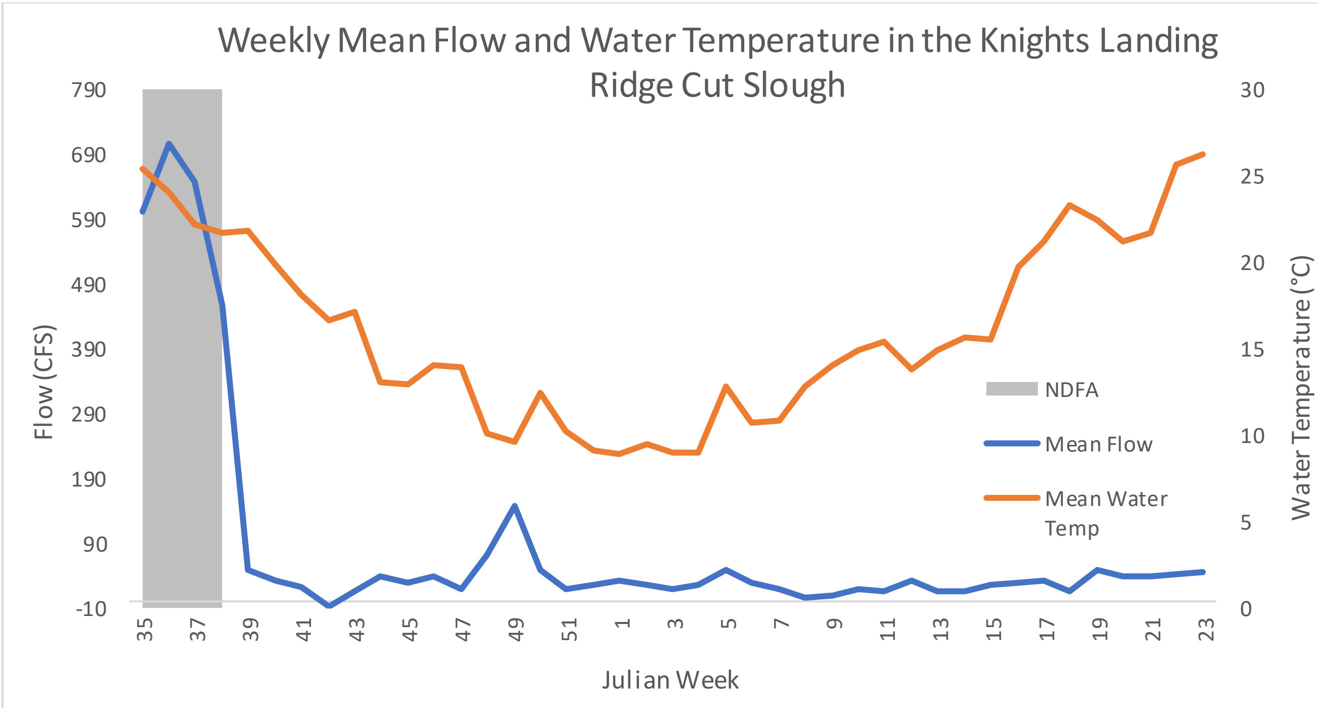

Figure 5. Mean weekly water temperatures (in degrees Celsius) and flow (in cubic feet per second) measured at the Wallace Weir Fish Collection Facility during the sampling season (Julian week 35 to 23). The vertical grey bar denotes when the North Delta Flow Action (NDFA) occurred. Water flow was reported by CDEC, Ridge Cut Slough (RCS) gage in cubic feet per second.

Table 1. Weekly average values of turbidity, dissolved oxygen measured in percent saturation, flow in the KLRCS in cubic feet per second, and water temperature in degrees Celsius, measured at the facility.

Julian Week	Beginning Date	Turbidity	D.O. (% saturation)	Flow (cfs)	Water Temp (°C)	Julian Week	Beginning Date	Turbidity	D.O. (% saturation)	Flow (cfs)	Water Temp (°C)
35	8/25/2019	20.11	N/A	602	25.3	**4**	1/19/2020	12.19	76.99	25	9.0
36	9/1/2019	20.83	45.30	706	24.1	**5**	1/26/2020	23.50	72.00	49	12.8
37	9/8/2019	30.80	51.95	648	22.2	**6**	2/2/2020	15.30	69.63	30	10.7
38	9/15/2019	28.58	52.81	456	21.6	**7**	2/9/2020	29.45	79.48	19	10.9
39	9/22/2019	22.43	51.43	48	21.8	**8**	2/16/2020	9.78	76.67	6	12.9
40	9/29/2019	14.55	46.38	33	19.9	**9**	2/23/2020	6.97	69.39	8	14.0
41	10/6/2019	18.63	65.73	24	18.1	**10**	3/1/2020	15.58	72.01	18	14.9
42	10/13/2019	N/A	48.53	-8	16.6	**11**	3/8/2020	17.62	69.31	14	15.4
43	10/20/2019	N/A	54.22	16	17.2	**12**	3/15/2020	16.47	72.47	31	13.8
44	10/27/2019	N/A	82.53	38	13.0	**13**	3/22/2020	16.43	72.44	16	14.9
45	11/3/2019	2.00	64.13	28	12.9	**14**	3/29/2020	14.78	81.34	15	15.7
46	11/10/2019	N/A	55.60	39	14.1	**15**	4/5/2020	N/A	74.43	24	15.6
47	11/17/2019	N/A	29.13	18	13.9	**16**	4/12/2020	N/A	74.63	27	19.7
48	11/24/2019	N/A	56.50	71	10.1	**17**	4/19/2020	N/A	66.01	31	21.2
49	12/1/2019	N/A	70.20	146	9.6	**18**	4/26/2020	N/A	59.49	15	23.3
50	12/8/2019	19.98	30.94	48	12.5	**19**	5/3/2020	N/A	64.16	49	22.5
51	12/15/2019	11.32	36.90	20	10.2	**20**	5/10/2020	N/A	63.46	39	21.2
52	12/22/2019	17.80	61.32	27	9.1	**21**	5/17/2020	N/A	62.36	38	21.7
1	12/29/2019	15.39	67.74	32	8.9	**22**	5/24/2020	N/A	61.49	41	25.7
2	1/5/2020	30.00	62.83	24	9.5	**23**	5/31/2020	N/A	68.01	44	26.2
3	1/12/2020	18.73	72.80	20	9.0						

Fish catch - During the 2019/2020 season 1,204 fish were captured during salvage operations in the KLRC. The total catch was comprised of 19 fish species, four of which were native (Table 2).

Table 2. Total catch of all fish species trapped and caught at and below the Wallace Weir collection facility between August 27, 2019 and June 2, 2020. *California native fish species.

Common Name	Scientific Name	Number Captured at WW
Chinook salmon*	*Oncorhynchus tshawytscha*	596
Steelhead*	*Oncorhynchus mykiss*	27
Bass, Largemouth	*Micropterus salmoides*	24
Bass, Striped	*Morone saxatilis*	12
Bass, Unid.	*Micropterus spp.*	3
Bullhead, Brown	*Ameiurus nebulosus*	41
Bullhead, Unid.	*Ameiurus spp.*	10
Catfish, Blue	*Ictalurus furcatus*	2
Catfish, Channel	*Ictalurus punctatus*	61
Catfish, Unid.	*Ictalurus spp.*	3
Catfish, White	*Ameiurus catus*	4
Common Carp	*Cyprinus tshawytscha*	274
Crappie, Black	*Pomoxis nigromaculatus*	56
Crappie, Unid.	*Pomoxis spp.*	12
Crappie, White	*Pomoxis annularis*	4
Chum Salmon	*Oncorhynchus keta*	1
Goldfish	*Carassius auratus*	7
Sacramento Pikeminnow*	*Ptychocheilus grandis*	1
Shad, Threadfin	*Dorosoma petenense*	34
Sacramento Sucker*	*Catostomus occidentalis*	22
Sunfish, Bluegill	*Lepomis macrochirus*	5
Sunfish, Redear	*Lepomis microlophus*	3
Sunfish, Warmouth	*Lepomis gulosus*	1

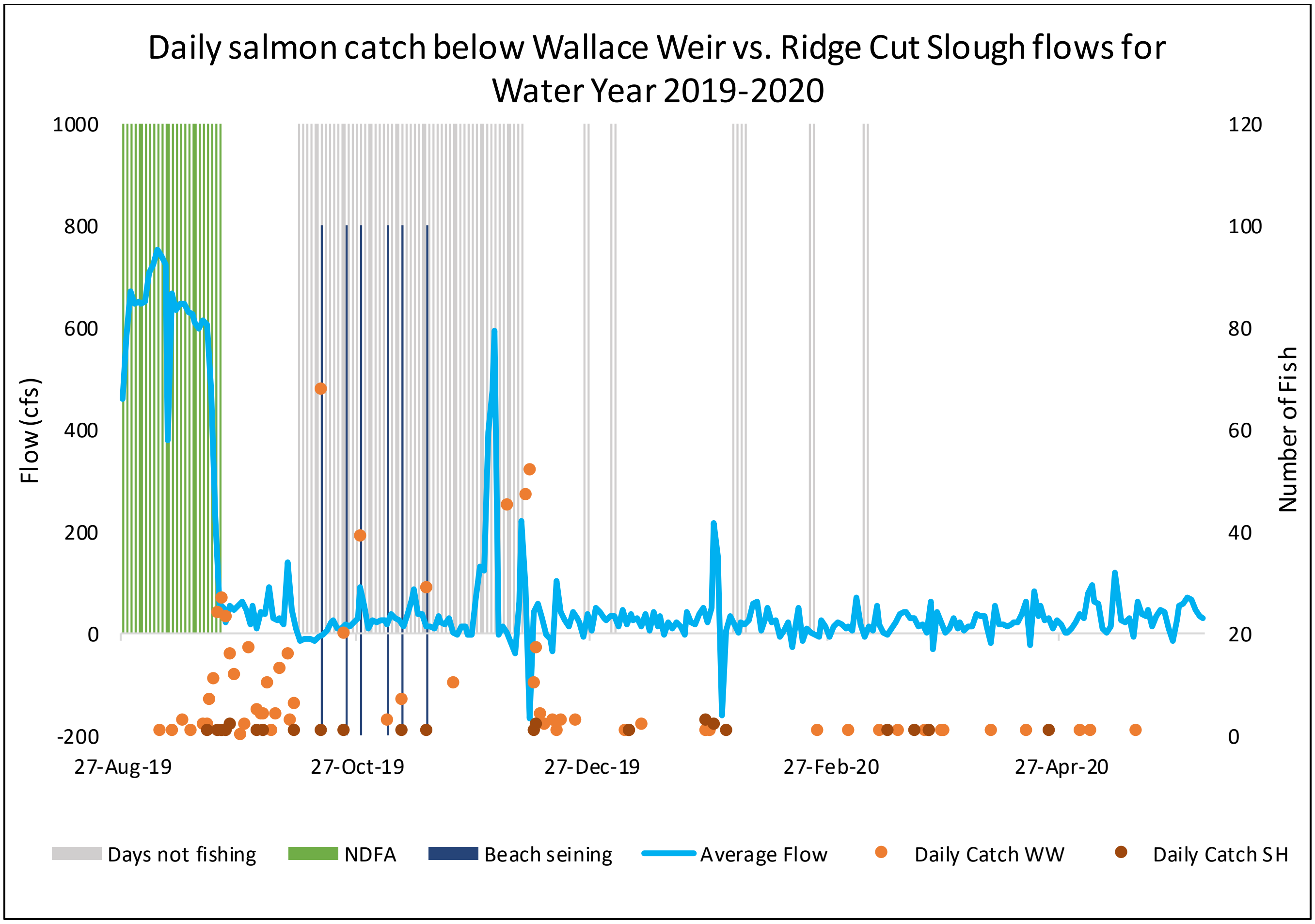

Figure 6. Daily total salmon and steelhead catch for trapping below Wallace Weir and daily high flows on the Ridge Cut Slough at Knights Landing gauge for water year 2019-2020. Gray Vertical lines indicate times the fish collection facility was not functioning. Green vertical lines indicate when the North Delta Flow Action took place. Purple lines indicate when beach seining occurred. River flows reported by CDEC, Ridge Cut Slough at Knights Landing (RCS) and reported in cubic feet per second (cfs).

Salmonids – A total of 596 Chinook salmon was captured in the KLRC during salvage operations, 77 of which were adipose fin-clipped. There were 28 steelhead captured during salvage efforts in the KLRC, 19 of which were adipose fin clipped (Table 3). During and immediately after the pulse flow, 128 Chinook salmon and 7 steelhead were captured at the facility.

Table 3. Total catch and recovery of mortalities of adipose fin intact and adipose clipped Chinook salmon and steelhead at and below the Wallace Weir collection facility between August 27, 2019 and June 2, 2020.

	Chinook Salmon Total	Chinook Salmon (Adipose Fin Intact)	Chinook Salmon (Adipose Fin Clipped)	Steelhead Total	Steelhead (Adipose Fin Intact)	Steelhead (Adipose fin not intact)
Alive	**554**	489	65	**25**	8	17
Mortalities	**42**	30	12	**2**	0	2
Grand Total	**596**	519	77	**27**	8	19

Genetics - Genetic analysis conducted on the samples taken from the Chinook salmon showed that there were 520 fall-run, 28 late fall-run, 4 winter-run and 10 spring-run captured during salvage efforts in the KLRCS. A run assignment was undetermined for 27 of the samples. To reduce handling stress, 7 Chinook salmon were not measured, tagged or sampled for genetics (Table 4) during a beach seining effort on October 18, 2019.

Table 4. Summary of run-assignments based on genetic analysis of Chinook salmon caught at and below the Wallace Weir collection facility.

RUN ASSIGNMENT	2019-2020 TRAPPING SEASON
FALL RUN	520
LATE-FALL RUN	28
WINTER-RUN	4
SPRING-RUN	10
NOT REPORTED	27
NOT SAMPLED FOR GENETICS	7
Total	596

Post release recoveries - There were 7 floy tag recoveries and 5 PIT tag detections of fish post release from salvage efforts in the KLRCS by researchers, hatchery staff and anglers throughout the Central Valley. The floy tag recovery locations include the Feather River Hatchery, the Feather River Hatchery side channel, Clear Creek and the Sacramento River. PIT tag detections occurred on Battle Creek, the Yuba River and one tag was scanned at the Red Bluff office after a tagged steelhead was captured and brought to the office by an angler (Table 5).

Table 5. Recovery dates and locations of Floy tagged Chinook salmon released at the Elkhorn Boat Launch on the Sacramento River during 2019-2020 season.

Tag & release date	Recovery Date	Species	Recovery time (days)	Recovery Condition	Spawning Condition	Recovery Location
10/18/2019	11/4/2019	Chinook salmon	17	Dead	Not reported	Clear Creek
10/7/2019	11/4/2019	Chinook salmon	28	Dead	Not reported	Clear Creek
10/11/2019	11/5/2019	Chinook salmon	25	Live	Hat. culled	Feather River Hatchery
10/18/2019	11/7/2019	Chinook salmon	20	Dead	Not reported	Clear Creek
10/4/2019	11/19/2019	Chinook salmon	46	Dead	Not reported	Feather River Hatchery side channel
12/10/2109	12/10/2019	Chinook salmon	0	Live	Not reported	Sacramento River near Knights Landing, RM 91.48
12/12/2019	1/3/2020	Steelhead	22	Live	Unspawned	Sacramento River near Bend Bridge

CWTs - Between October and December of 2019, 31 coded wire tags (CWT) were extracted from Chinook salmon that were either sacrificed or recovered from mortalities found in the KLRCS near the facility between October and December of 2019. The CWTs were all from hatchery produced fall-run fish produced by the following hatcheries: 21 from the Mokelumne River Hatchery, 6 from the Coleman National Fish Hatchery, 3 from the Feather River Hatchery, and 1 from the Nimbus Fish Hatchery. All hatchery fish were from either brood year 2016 or brood year 2017 (Table 6).

Table 6. Coded Wire Tag (CWT) recovery of Chinook salmon during salvage efforts at the Wallace Weir collection facility during the 2019-2020 season.

# Of fish	CWT#	Recovery date	Hatchery of Origin	Brood year	Release year
2	056065	11/14/2019	Coleman National	2016	2017
1	056074	11/21/2019	Coleman National	2016	2017
1	056077	12/5/2019	Coleman National	2016	2017
1	056080	11/14/2019	Coleman National	2016	2017
1	056084	12/5/2019	Coleman National	2016	2017
6	060598	12/5/2019, 12/10/2019, 12/12/2019	Mokelumne River	2016	2017
2	060655	11/18/2019	Feather River	2017	2018
1	060950	12/10/2019	Mokelumne River	2016	2017
2	060951	12/10/2019, 12/11/2019	Mokelumne River	2016	2017
2	060952	12/5/2019, 12/11/2019	Mokelumne River	2016	2017
1	060970	10/18/2019	Feather River	2016	2017
1	060979	11/14/2019	Mokelumne River	2016	2017
1	060981	12/11/2019	Mokelumne River	2016	2017
1	060983	12/11/2019	Mokelumne River	2016	2017
5	060986	12/10/2019	Mokelumne River	2016	2017
1	061203	12/10/2019	Mokelumne River	2016	2017
1	061468	12/10/2019	Nimbus	2017	2018
1	061484	11/14/2019	Mokelumne River	2017	2018

Discussion

This was the first season using the permanent fish collection facility for salvage operations at Wallace Weir. The facility allowed for salvage operations to occur in higher flows than previous temporary trapping methods (i.e., fyke traps). The logistics of capturing and processing fish caught in the facility were safer and easier than temporary traps. Temporary traps were in parts of the channel where staff needed to walk up and down a steep levee embankment in order to check the trap and transfer fish to a transport trailer. The traversing of the levee embankment would often present potential slip, trip and fall hazards for field staff. The equipment for operating the facility is located at the top of the levee and allows for fish to be concentrated near the surface, eliminating the need for field staff to walk down steep levee embankments. Although the facility allowed for trapping to occur in a wider range of flows and was generally safer and made fish capture and processing easier, it did not necessarily result in higher numbers of salmon caught during the season compared to other seasons where temporary traps were used. The species composition was also similar to what has been observed in previous season's trapping efforts. Additionally, the facility requires regular maintenance and in the event of equipment failure or malfunction, repairs would need to be done by the original subcontractor that built the facility. This is due to much of the equipment being larger in scale or having complex electrical components. The facility overall is an improvement on temporary trapping methods used in the KLRC for salvaging listed species of adult fish but still needs modification and is not a permanent solution for preventing entrainment of salmonids and sturgeon in the bypass outside of flooding events.

The maximum hours fished by a temporary trap was 3,750 (2014/2015 season) while the facility was fished for 4285. However, the maximum number of salmonids captured during a trapping season occurred during the 2015/2016 season with 827 Chinook salmon over 1738 hours while the facility captured 623 salmonids during the 2019/2020 season. Even though the facility was fished for a longer period of time during the 2019/2020 season, the CPUE did not exceed that of seasons when a temporary trap was used. During periods of higher flows when the facility was fished, no salmonids were captured until the flows receded. This may have been because flows were being released through the bays of the water control portion of the weir and far exceeded the flows coming from the fish collection facility portion of the weir, causing false attraction towards the water control structure.

The facility was rendered inoperable due to mechanical failures of the slide gate and crowder rack for 67 days this season. These components are large and difficult for most field staff to trouble shoot right away and requires much more advanced expertise to fix. This is one of the pitfalls of using a facility with larger and more robust components compared to temporary traps. Further training of field staff and simplification of controls may alleviate this issue in the future.

Fall-run Chinook salmon was the most numerous species captured in the facility. This has been the case for most of the trapping efforts below Wallace Weir, either in the KLRC or the Toe Drain. What was more unusual was the ratio of adipose fin clipped to adipose intact fall-run Chinook salmon captured in the facility compared to other seasons of fish salvage efforts in the bypass. Typically, ratios of adipose clipped to adipose intact fall-run Chinook salmon have been closer to 25 percent, more reflective of the constant fractional marking rates of fall-run producing Central Valley hatcheries.

Most of the CWT's read from sacrificed or recovered Chinook salmon carcasses indicated that they were from the Mokelumne River Hatchery. This is likely due to the release strategies used by the hatchery. Juveniles from the Mokelumne Hatchery are released via net pens in the San Joaquin Delta, near Sherman Island. Chinook salmon smolts are trucked directly from the hatchery to the net pens in the delta, so the natural imprinting on the river does not occur, likely contributing to the straying of these fish.

During the North Delta Flow Action study, it was expected that the higher flows through the KLRC would attract more salmon to the facility than normal flows in the canal during the late summer/early fall. There were fewer salmon captured during the pulse flow than after flows began to ramp down (Figure 6). During the pulse flow, there was more water flowing over the water control structure at Wallace Weir than through the fish collection facility. A maximum flow of over 700 cfs through the KLRC was recorded during the pulse flow, and the collection facility has a maximum flow rate of 50 cfs. Since most of the flow was going through the water control structure instead of the fish collection facility, it may be that there was very little attraction towards the facility for fish during the pulse flow resulting in fewer fish being caught until flows were ramped down. This may be problematic during future high flow events outside of experimental pulse flows and during periods where ESA listed salmonids such as winter and spring-run Chinook salmon may be present.

Due to high water temperatures observed in the KLRC during the pulse flow study, none of the salmonids captured during that time were not tagged or measured to reduce handling stress. Mean weekly water temperatures during the pulse flow were above 21 degrees Celsius (Figure 5 and Table 1) which were well above the upper lethal limit Chinook salmon can tolerate (Richter and Kolmes, 2005). As a result of the high water temperatures and no tags being applied to these fish, their fates post release will never be known.

A total of 7 floy tags and 5 PIT tags were later recovered and detected, respectively, post release. Considering a total of 596 Chinook salmon and 27 steelhead were observed at the facility, this is a small number of fish (1.9 percent) that were recovered post release. Although floy tags and PIT tags offer insight as to where these fish end their migration, it is not telling of the entire migration from when they are released from salvage efforts to the time they are recovered elsewhere. There is also a lack of data for the fish that were not recovered and why. There may be multiple reasons why fish were not recovered post release, such as lack of floy or PIT tag detection, tag shedding, mortality immediately after release, predation, etc. Although floy and PIT tags offer some insight as to where these fish end their migration, it is not telling of the entire migration route. Further research is needed to determine the fate of all fish released from the facility back into the river.

The new Wallace Weir Fish Collection Facility was successful in providing a safer and easier means of capturing straying salmonids in the KLRC compared to temporary traps. Despite the increased robustness of the trapping equipment in the facility and the wider range of flow conditions it can withstand, it has not increased the capture efficiency from previous temporary trapping methods. Due to the robustness of the equipment in the facility, mechanical failures in the equipment leave trapping efforts more vulnerable to longer periods of downtime awaiting repairs. The number of fish captured using the facility was similar to the numbers observed in previous seasons, and the number of fish recovered post release remains relatively low. It is also unclear as to why there are so few returns of fish from these salvage efforts post release. The use of the facility for capturing and relocating salmonids in the KLRC is an improvement from using temporary trapping methods as far as safety, but there are still improvements that can be made to the facility and overall, this is not a permanent solution to the issue of adult salmonids straying into the bypass.

References

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