2016 Clear Creek Technical Team Annual Report for the Coordinated Long-Term Operation Biological Opinion

Table of Contents

Acronyms and Abbreviations

BO	Biological Opinion
CCRP	Clear Creek Restoration Program
CCTT	Clear Creek Technical Team
CDFW	California Department of Fish and Wildlife
CLTO	Coordinated Long-term Operation
cfs	Cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
FWS	U.S. Fish & Wildlife Service
GMA	Graham Matthews and Associates
IFIM	Instream Flow Incremental Methodology
NMFS	NOAA's National Marine Fisheries Service
OBTCC	Oak Bottom Temperature Control Curtain
Reclamation	U.S. Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
SCTCC	Spring Creek Temperature Control Curtain

CHAPTER 1. BACKGROUND

1.1 Brief background on Clear Creek and the Technical Team:

Since 1995, Central Valley Project Improvement Act (CVPIA) and later CALFED Bay-Delta Program have undertaken anadromous salmonid habitat and flow restoration in Clear Creek (Figure 1). The restoration has increased stocks of Central Valley (CV) fall-run Chinook Salmon (*Oncorhynchus tshawytscha*) four fold (population estimate average = 1,749 from 1967 to 1991, and 7,697 from 1992-2015), and re-established populations of Central Valley spring-run Chinook Salmon and California Central Valley (CCV) steelhead (*O. mykiss*). The Clear Creek Technical Team (CCTT) has been working since 1996 to facilitate implementation of these CVPIA and CALFED restoration actions. Team attendance and participation have varied over the years depending on what topics are being covered in the meetings. The majority of the topics had involved physical habitat restoration. Since 2009, topics have included NOAA's National Marine Fisheries Service's (NMFS) Coordinated Long-Term Operations (CLTO) biological opinion (BO) Reasonable and Prudent Alternative (RPA) actions including flow and temperature management on Clear Creek.

The Clear Creek Restoration Program (CCRP) of CVPIA identified and implemented a variety of actions to improve salmon and steelhead populations and the ecosystem on which they depend, including increasing minimum flows, temperature control through flow management, dam removal, large-scale stream and floodplain restoration, gravel augmentation, and erosion control. The effect of these actions has:

1) increased the escapement of fall-run Chinook Salmon four fold, primarily due to increased minimum flows;
2) re-established populations of threatened CV spring-run Chinook Salmon and threatened CCV steelhead, primarily through dam removal, increased flows and temperature management;
3) rehabilitated of stream and floodplain habitats;
4) re-initiated of sediment transport and stream channel movement processes, in some reaches, which help create and maintain fish habitat; and
5) increased the amount of spawning habitat.

The actions are also believed to have increased the resilience of the CV fall-run Chinook Salmon population, allowing it to perform better than the rest of the CV watersheds during the 2007 to 2010 coastal Chinook fishery collapse. During that period, while CV fall-run Chinook Salmon escapement decreased to 24% of baseline (in-river plus hatchery estimates from 1992 to 2006), Clear Creek maintained an average 74% of baseline escapement (1992 to 2006). Since the collapse CV-wide escapement has averaged 72% of baseline and Clear Creek has averaged 134% of baseline.

1.2 Current Active Members

Naseem Alston, NMFS
Mike Berry, CDWR
Tricia Bratcher, CDFW
Matt Brown, USFWS
Leslie Bryan, Redding Electric Utility
Charles Chamberlain, USBR
Guy Chetelat, RWQCB
James Earley, USFWS
Eda Eggeman, CDFW
Kendra Fallon, BLM
Sarah Gallagher, USFWS
Jennifer Gibson, NPS
Matt Johnson, CDFW
Jason Roberts, CDFW
Brycen Swart, NMFS
Maureen Teubert, WSRCD

There are additional people from various agencies and entities that participate on a less frequent basis.

1.3 List of Clear Creek Technical Team Discussions:

The following list of topics were covered in CCTT meetings in WY 2016:

December 10, 2015

- Stinkwort invasive plant species
- Spring-run Chinook Salmon population
- Pulse flows and observations
- Summer water temperatures
- Gravel Injection 2016 update
- Oak Bottom Temperature Curtain update
- Phase 3C update
- Clear Creek Environmental Water Program update
- Lower Clear Creek Aquatic Habitat and Mercury Abatement Project update
- Meeting schedule for 2016

January 30, 2016

- CVPIA AWP FY17: New Project Selection Process for Charters
- Presentation of Phase 3C Denver TSC Channel Alignment
- Spring Pulse Flow Coordination
- 2015 Fall-Run Chinook Salmon Escapement Monitoring Presentation
- Gravel Program Goal Setting Discussion

March 3, 2016

- Fall-run Chinook escapement monitoring presentation
- Update on flow study synthesis report

- Discussion of pulse flows
- Update on Lower Clear Creek Aquatic Habitat Mercury Abatement Program

June 16, 2016

- Pulse flow update
- Phase 3C update
- Proposed CVPIA 2017 budget
- Summer flows, gate operations and water temperatures
- NMFS BO flow prescription
- Discuss preparation of 2016 Clear Creek Technical Team Annual Report
- Discuss preparation of 2016 Gravel Evaluation Report

CHAPTER 2. SUMMARY OF CLEAR CREEK RPA ACTIONS

RPA Action Item	Progress in WY 2016
I.1.1. Spring Attraction Flows	Yes
I.1.2. Channel Maintenance Flows	No
I.1.3. Replace Temperature Curtain	Yes
I.1.4. Thermal Stress Reduction	Yes
I.1.5. Adaptively Manage to Habitat Suitability / IFIM Study Results	Yes
Other required monitoring and operations	Yes

Implementation of RPA Actions in WY 2016

2.1.1 Action I.1.1. Spring Attraction Flows

Objective: Encourage spring-run movement to upstream Clear Creek habitat for spawning.

Action: "Reclamation shall annually conduct at least two pulse flows in Clear Creek in May and June of at least 600 cfs for at least three days for each pulse, to attract adult spring-run holding in the Sacramento River main stem. This may be done in conjunction with channel-maintenance flows (Action I.1.2)".

Results:

Three pulse flows were provided from Whiskeytown Dam (Table 1). The timing was chosen to coincide with previously observed peak adult spring-run Chinook Salmon migration, and replicate the spring-run Chinook Salmon attraction success observed during past June pulse flows. A third pulse flow was added in 2016 to provide another opportunity to attract spring-run Chinook Salmon. Previous years' pulse flow monitoring results suggested that spring-run Chinook Salmon passage was greater in the earlier portion of a pulse flow. The duration of the peak and down ramping period was shortened for the first two pulse flows, providing a water savings and opportunity to have a third pulse flow.

Table 1. 2016 Clear Creek pulse flow timing, duration, and magnitude.

Date	Peak	Acre feet used
May 23-28	400 cfs	1,354
June 6-11	400 cfs	1,230
June 20-27	800 cfs	4,669

Adult spring-run Chinook Salmon upstream passage into Clear Creek was monitored during their migration period (March 1-August 15) at a video station near the confluence with the Sacramento River. During high water turbidity events when visibility on the underwater and overhead cameras was low to zero, ARIS sonar was used to record Chinook Salmon passage. While there was no significant difference in the number of spring-run per day passing the video station during pulse and non-pulse periods (t=1.104, p = 0.27, df =91), spring-run passage occurred during all three pulse flow events, and the average number of fish passing during the pulse was higher (average = 1.35 fish per day SE = 0.46) than during the non-pulse period (average = 0.90, Se = 0.17). (Table 2 & Figure 2). In addition the power of the t-test (b = 0.07) was below the desired power of b = 0.80. The average number of spring-run that passed per day during each pulse flow was greater than what passed in the periods before and after (Table 2). Flow increases during ramping corresponded to increased turbidity at the P4 gauging station (Figure 3). The average number of spring-run that passed during each 5-day period following the first two pulse flows, and in the 9-day period prior to the third pulse flow, was only slightly less than what passed during each pulse flow. A small storm event created turbidity and decreased water temperatures prior to the third pulse flow, which may have attracted spring-run (Figure 2). Downstream spring-run passage during the down-ramping of the third pulse flow, and in the period following the pulse flow coincided with warming water temperatures (Figure 2). Total spring-run upstream passage during all pulse flows combined was 27.

Table 2. Number of adult spring-run Chinook Salmon and length of period in days, and the average number of salmon passing per day for the three pulse flow evaluation periods in Clear Creek during spring 2016.

	Number of salmon	Days	Average fish per day
Pre	1		0.2
Pulse 1	7	5	1.4
Post	6		1.2
Pre	2		0.4
Pulse 2	8	5	1.6
Post	6		1.2
Pre	10		1.1
Pulse 3	12	9	1.3
Post	-1		-0.1

Snorkel surveys were conducted the week before and after each pulse flow to locate and count adult spring-run Chinook Salmon. Counts of spring-run Chinook Salmon increased following each pulse, which also corresponded to increased upstream passage observed at the video station (Figure 4). Holding distribution observed during snorkel surveys changed little following each pulse flow, and 96% of the spring-run Chinook Salmon snorkel count remained downstream of the temperature compliance point at the USGS Igo gauging station (IGO) (river mile 11.0) during the final post pulse snorkel survey (Figure 5).

The adult spring-run Chinook Salmon annual population index snorkel survey count occurs in late August just prior to spawning. In 2016, the spring-run Chinook Salmon population index was 29, a decline from the final post pulse snorkel survey count of 70. Ninety percent of the spring-run Chinook Salmon index was located downstream of IGO, compared to a range of 25%-72% from 2003-2015 (Figure 5).

2.1.2 RPA Action I.1.2. Channel Maintenance Flows

Objective: Minimize project effects by enhancing and maintain previously degraded spawning habitat for spring-run Chinook Salmon and CCV steelhead.

Action: "Reclamation shall re-operate Whiskeytown Glory Hole spills during the winter and spring to produce channel maintenance flows of a minimum of 3,250 cfs mean daily spill from Whiskeytown for one day, to occur seven times in a ten-year period, unless flood control operations provide similar releases. Re-operation of Whiskeytown Dam should be implemented with other project facilities described in the Environmental Water Program (EWP) Pilot Program".

Results: This RPA action has yet to be implemented. Implementation of this RPA action through the Clear Creek Environmental Water Program (EWP) has ceased due to lack of progress. The critical step holding up the process is the review of six technical memos by Reclamation staff. In 2012 and 2013 the following six Technical Memos were developed to guide the program based in part on a 3-day workshop involving Reclamation, the fish agencies, and representatives of the power industry:

- Proposed Project & Related Operational Changes;
- In-season, real-time coordination & tools required to support decision-making;
- Foregone Power Mitigation;
- Regulatory approvals and permitting;
- Disposition of Dam Safety & Downstream Safety Issues; and
- Miscellaneous considerations & other potential impacts.

The EWP pilot program was fully funded by the Ecosystem Restoration Program of the CDFW. However, due to the lack of progress, the contract between CDFW and the FWS was cancelled on January 1, 2016. While pre-project monitoring has continued under CVPIA funding, all other efforts have ceased pending review of the technical memos. In a September 14, 2016 a meeting was held to jump start this RPA action. Reclamation review of the technical memos was one of the resulting action items.

In addition, development of the EWP toolkit has stopped because Reclamation's Central Valley Operations (CVO) has not provided data to the EWP contractor. The EWP toolkit is designed to provide real-time information for use by CVO operators to manage EWP re-operations of Whiskeytown Reservoir. CVO operators had asked to have these tools developed including improved precipitation forecasting in the Clear Creek watershed, and a user interface to provide the data necessary for making decision such as Trinity River water storage and releases, and Sacramento discharge at Bend Bridge. For Reclamation to use the tools and for development of the tools, real-time hydrologic data needs to be available to the consultant building the toolkit.

2.1.3 RPA Action I.1.3. Spawning Gravel Augmentation

Objective: Enhance and maintain previously degraded spawning habitat for CV spring-run Chinook Salmon and CV steelhead.

Action: "Reclamation, in coordination with the Clear Creek Technical Team, shall continue spawning gravel augmentation efforts. By December 31 each year, Reclamation shall provide a report to NMFS on implementation and effectiveness of the gravel augmentation program".

Results: Gravel was injected at 4 sites (11,000 tons) and stockpiled for future injection at 1 site (1,000 tons) in Clear Creek in 2016 (Table 3)

Table 3. Clear Creek gravel program quantities 2016.

Location	Amount (tons)
Below Dog Gulch	2,000
Guardian Rock	2,000
Placer Road Bridge	4,000
Above 3A	3,000
Stockpile near 3A	1,000
Total	12,000

The Lower Clear Creek Aquatic Habitat and Mercury Abatement Project:

> CVPIA funded planning, design and permitting for this project to provide an inexpensive, long-term gravel supply for Clear Creek restoration. The project, which is located on Bureau of Land Management and CDFW land, could provide gravel for 20 to 40 years at a much reduced acquisition cost. In February 2012, the Ecosystem Restoration Program decided to fund the entire 4-year project ($4.5 million) using a combination of Proposition 13 Mine Remediation and Proposition 84 funds. Revisions to the project design are being implemented with active assistance from the CCTT. Implementation of this project is expected to begin in 2016.

2.1.4 RPA Action I.1.4. Spring Creek Temperature Control Curtain

Objective: Reduce adverse impacts of project operations on water temperature for listed salmonids [Sacramento River winter-run Chinook Salmon, CV spring-run Chinook Salmon, CCV steelhead] in the Sacramento River.

Action: "Reclamation shall replace the Spring Creek Temperature Control Curtain in Whiskeytown Lake by 2011".

Results: Replacement of the broken SCTCC in 2011 was one component of a strategy intended to reduce the temperature of water diverted to the Sacramento River via the Spring Creek tunnel. This down-reservoir curtain was designed to pull cold water from lower levels of Whiskeytown Reservoir. The new Oak Bottom Temperature Control Curtain (OBTCC) installed in May is intended to prevent mixing of cold and warm water at the upper end of the reservoir. Modeling shows that, when functional, OBTCC exerts even more influence on water temperatures than the SCTCC. The CCTT recognizes the importance of having the SCTCC and OBTCC functioning together in tandem, and being maintained in proper working condition to reduce water temperatures of water that is released into Clear Creek through Whiskeytown Dam, as well as the Sacramento River via the Spring Creek Tunnel.

2.1.5 RPA Action I.1.5. Thermal Stress Reduction

Objective: To reduce thermal stress to over-summering CCV steelhead and CV spring-run Chinook Salmon during holding, spawning, and embryo incubation.

Action: **"**Reclamation shall manage Whiskeytown releases to meet a daily water temperature of:

1) 60°F at the Igo gage from June 1 through September 15; and
2) 56°F at the Igo gage from September 15 to October 31.

Reclamation, in coordination with NMFS, will assess improvements to modeling water temperatures in Clear Creek and identify a schedule for making improvements."

Results: For the 2015 spring-run Chinook Salmon spawning period, mean daily water temperatures at IGO continually exceeded 56°F during the criteria period, ranging from 57.0 – 59.5°F (Figure 7). In this range, eggs and embryos were exposed to water temperatures that may incur 8 to 25% mortality (Figure 8). Redds upstream of IGO (38% of the spring-run Chinook Salmon redd count) were exposed an average range of 52-73% incubating days over 56°F. The remaining spring-run Chinook Salmon redds downstream of IGO were exposed an average range of 58%-80% incubating days over 56°F.

In 2016, water temperature criteria was met at Igo for 98% of the spring-run Chinook Salmon holding period (Table 4 & Figure 9). Water temperatures exceeded criteria on July 15 and 16 while flows were 90 and 96 cfs. Following the final pulse flow in late June, 96% of the spring-run Chinook Salmon snorkel count (*N*=70) was downstream of IGO, with 37 located in a large holding pool (North State Pool) at river mile 4.49 (Figure 10). In an attempt to move spring-run Chinook Salmon to upstream habitat, flows were lowered gradually at Whiskeytown Dam to warm water temperatures in the lower watershed, while still meeting holding criteria at IGO. Following the final pulse, flows were set at 125 cfs. On July 6, they were decreased to 110 cfs, and to 95 cfs on July 7. When water temperatures exceed 60°F at IGO, flows were increased to 110 cfs on July 19, and again to 130 cfs on July 24, where they remained through the rest of the holding period. During this flow decrease period, adult spring-run Chinook Salmon were counted by snorkel survey in the North State Pool on three dates. The count was 40 salmon on July 11, 22 salmon on July 21, and 22 salmon on August 4 (Figure 9). During the reduced flow period from July 7-24, mean daily water temperatures increased near the holding pool at river mile 3.62, and ranged from 63.4°F to 67.1°F (average 65.5°F) (Figure 9). When flows were increased, water temperatures cooled and ranged from 58.4°F to 65.6°F (average 62.4°F) through the rest of the holding period (Figure 9).

The spring-run Chinook Salmon population index was 29, lower than the final pulse post snorkel count of 70. This decrease could be attributed to pre-spawn mortality, upstream and downstream migration, and/or snorkel observer inaccuracy. The main decrease occurred in North State Pool where there were only two spring-run Chinook Salmon counted on August 23, compared to earlier count as high as 40 (Figure 9). During the August Index snorkel survey, one pre-spawn mortality spring-run Chinook Salmon carcass was collected, and compared to the final pulse post snorkel count, four additional adult live salmon were counted upstream of the Gorge Cascade (river mile 6.54). In addition, four spring-run Chinook Salmon were detected passing downstream of the video weir station by August 6. Since snorkel survey counts were approximately 25-75% lower than video estimates, spring-run redd counts will provide more insight into potential mortality, and distribution changes following the summer holding period.

Table 4. Proportion of days that water temperatures at Clear Creek IGO gage met targets.

	Holding temperature ≤60°F June 1 to Sept 14	Spawning temperature ≤56°F Sept 15 to October 31
Pre-2009 (average)	99%	93%
2009	100%	26%
2010	100%	26%
2011	100%	62%
2012	100%	64%
2013	100%	96%
2014	100%	0%
2015	100%	0%
2016	98%	15%

Reclamation has not yet assessed improvements to modeling water temperatures in Clear Creek nor identified a schedule for making improvements. The 2011 amendment to the 2009 RPA, Section 11.2.1.2 (page 10) states that the "Temperature monitoring and modeling identified in RPA Action I.1.5" is one of the five "specific research projects that have been identified as important to begin in the first year and complete as soon as possible".

In April 2011, NMFS wrote to Reclamation amending the 2009 BO. One of the purposes of the letter was to: "(4) highlight the need… to explore options to avoid non-compliance with the RPA". This was specifically related to this action.

In 2011 the Independent Review Panel stated:

"The IRP believes that a model for management of Whiskeytown Reservoir would be valuable… The panel suggests that a more quantitative model-based program is needed to efficiently utilize the limited cold water resources in the Central Valley reservoirs… take real definitive actions to better coordinate the temperature control programs and commit real resources… includes alternative operations like seasonal shifts in Trinity River diversions to maintain cold water moving through the reservoir to the Sacramento River… measuring and reporting real-time water column temperatures in the reservoirs and possibly additional stations in the Sacramento River and tributaries that impact water temperature."

2.1.6 RPA Action I.1.6. Adaptively Manage to Habitat Suitability/IFIM Study Results

Objective: Decrease risk to Clear Creek spring-run and CV steelhead population through improved flow management designed to implement state-of-the-art scientific analysis on habitat suitability.

Action: "Reclamation shall operate Whiskeytown Reservoir as described in the Project Description with the modifications in Action I.1 until September 30, 2012, or until 6 months after current Clear Creek salmonids habitat suitability (e.g. IFIM [Instream Flow Incremental Methodology]) studies are completed, whichever occurs later.

Reclamation will, in conjunction with the CCTWG, assess whether Clear Creek flows shall be further adapted to reduce adverse impacts on spring-run and CCV steelhead, and report their findings and proposed operational flows to NMFS within six months of completion of the studies. NMFS will review this report and determine whether the proposed operational flows are sufficient to avoid jeopardizing spring-run and CV steelhead or adversely modifying their critical habitats.

Reclamation shall implement the flows on receipt of NMFS' written concurrence. If NMFS does not concur, NMFS will provide notice of the insufficiencies and alternative flow recommendations. Within 30 days of receipt of non-concurrence by NMFS, Reclamation shall convene the CCTWG to address NMFS' concerns. Reclamation shall implement flows deemed sufficient by NMFS in the next calendar year."

Results: The FWS began a IFIM study on Clear Creek in 2004 looking at flow habitat relationships for salmon and steelhead. The results of the study are contained in four final reports. In addition, a fifth report known as the "Synthesis Report" takes the findings of the four IFIM studies and recommends flows based on flow habitat relationships.

The CCTT has proposed to include 5 types of flow in this proposed operational plan, including flows to:

1) meet habitat needs based on IFIM and habitat suitability study results;
2) provide temperature control;
3) move and maintain spawning gravels and create and maintain riparian vegetation;
4) avoid fish and redd stranding / dewatering; and
5) encourage anadromy of *Oncorhynchus mykiss* (steelhead / rainbow trout) through an adaptive management approach.

The CCTT (which includes a NMFS representative) intends the report to address and meet the needs of both the RPA Action I.1.6 and the CVPIA Clear Creek Restoration Program, which has a mandate under CVPIA to provide a long-term flow prescription to mitigate for the impacts of the CVP.

Recommendations: Working with NMFS and the CCTT, Reclamation should assess if Clear Creek flows should be further adapted to reduce adverse impacts on spring-run Chinook and steelhead and encourage the restoration of these runs/species.

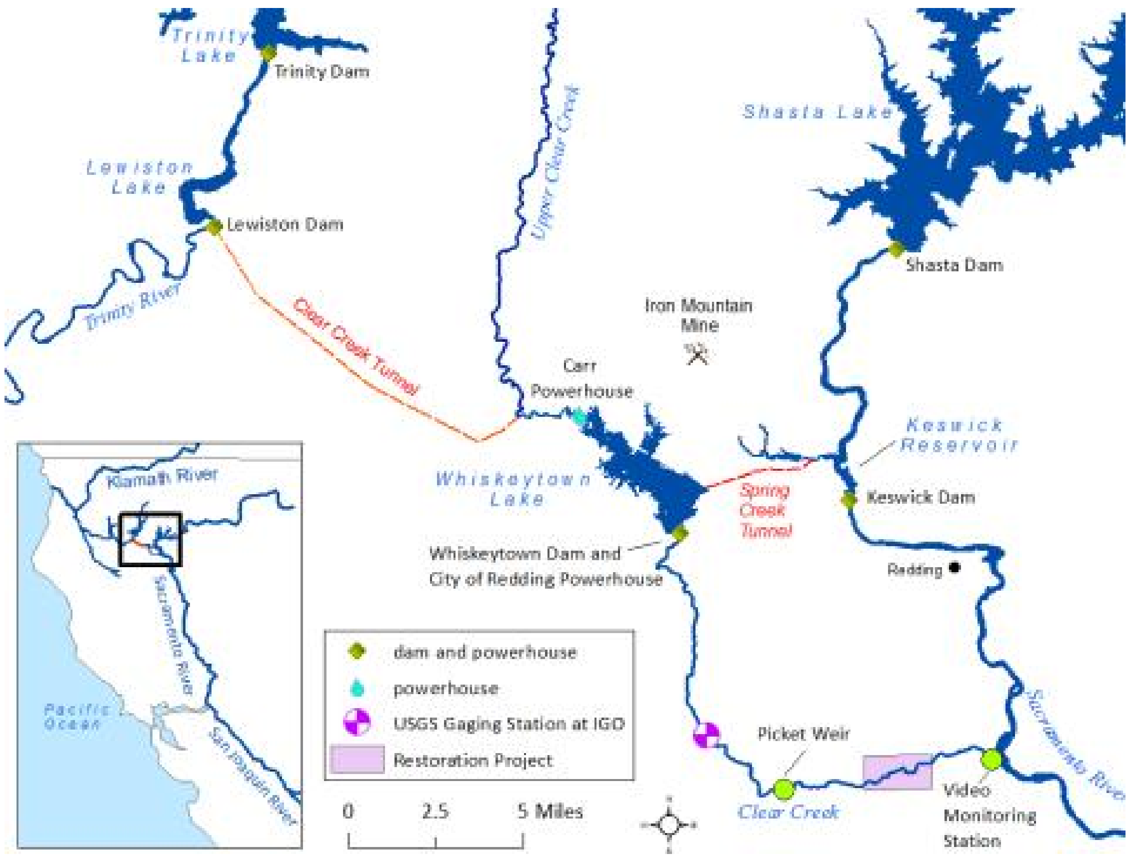

Figure 1. Location of Lower Clear Creek in Northern California, showing Trinity, Whiskeytown, and Shasta Reservoirs and related CVP facilities.

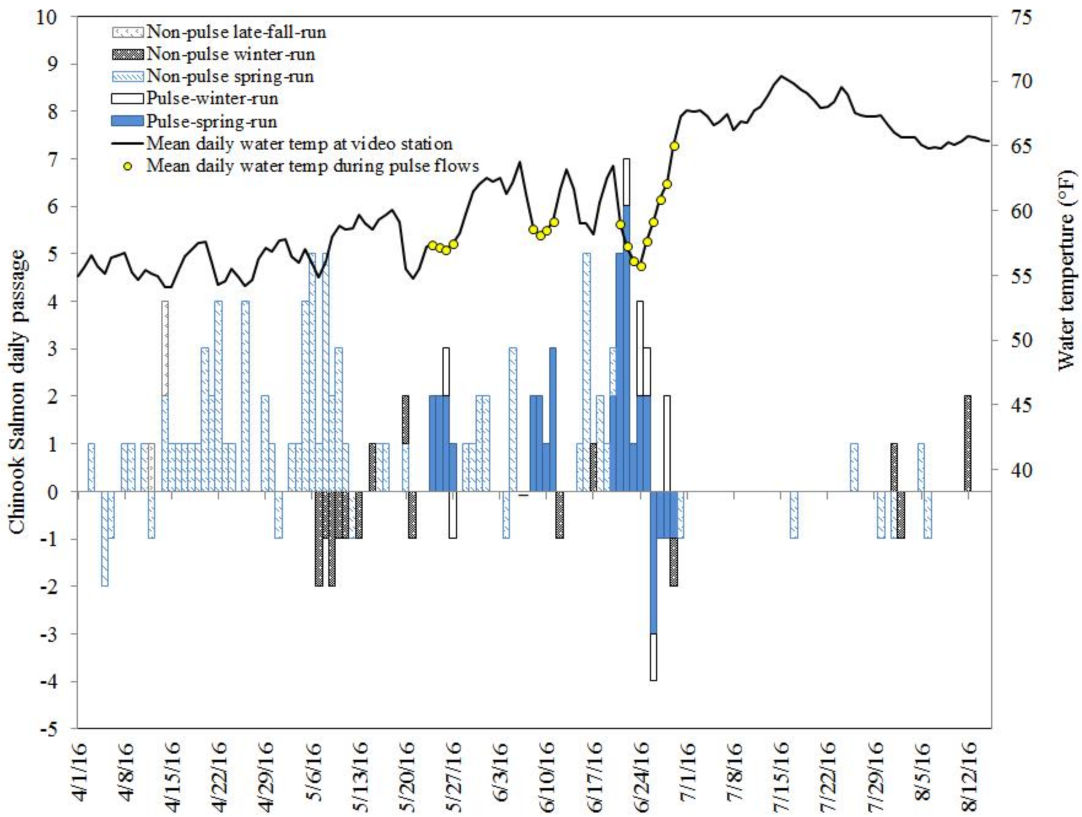

Figure 2. Chinook Salmon daily passage at the Clear Creek video weir station during the spring-run Chinook Salmon migration period. Bars show Chinook Salmon run (winter, spring, or late-fall) and designate if the salmon passed during one of the three pulse flow events. Mean daily water temperatures at the video weir station are shown with pulse flow days highlighted.

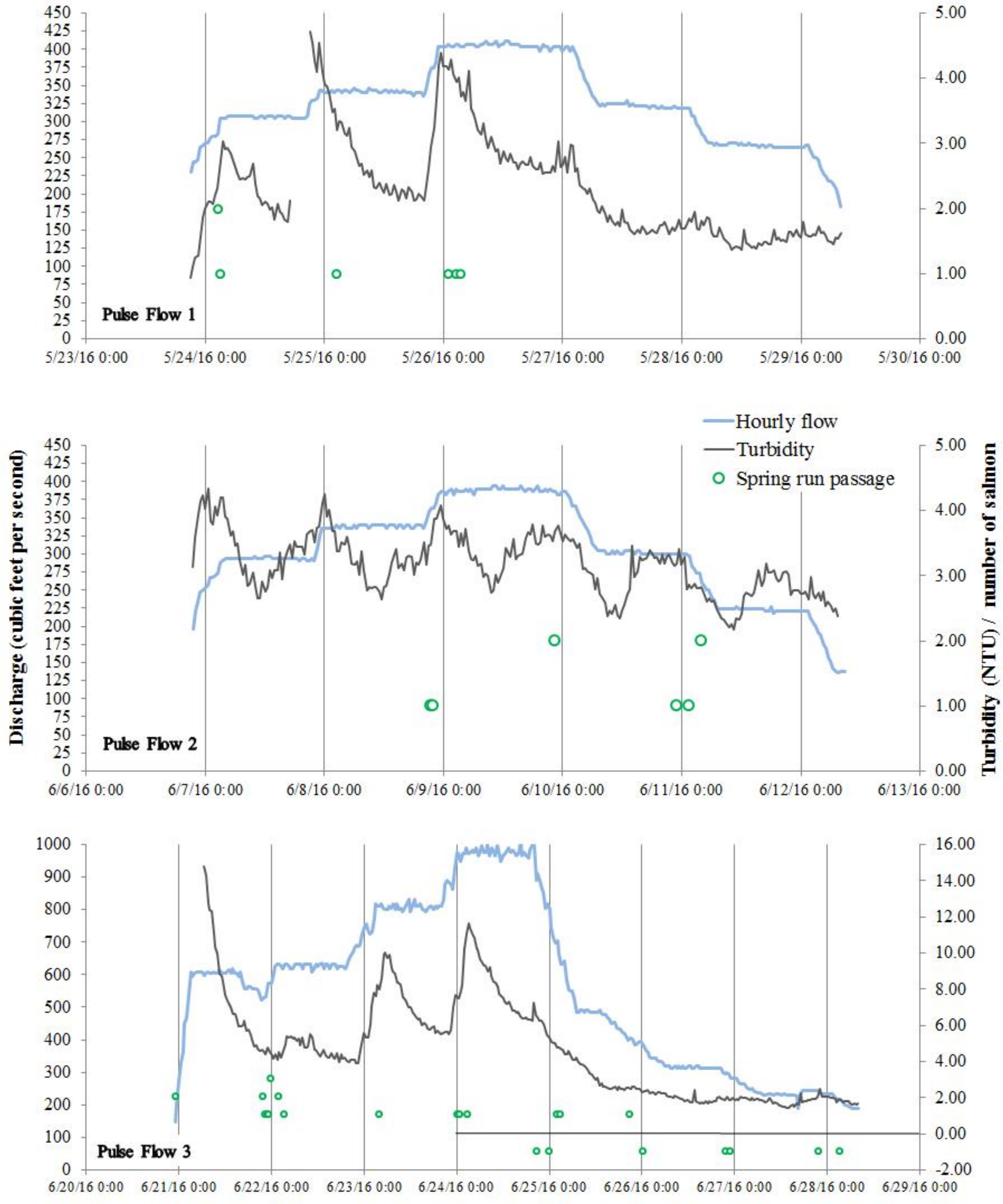

Figure 3. Spring-run Chinook Salmon passage at the Clear Creek Video Station (CCVS) during pulse flows, 2016. Turbidity data was from the P4 gauging station, and flows were taken from the USGS gauging station at Igo (IGO), and both are graphed to show timing at the CCVS. Turbidity and flow data are draft as of 10/07/16.

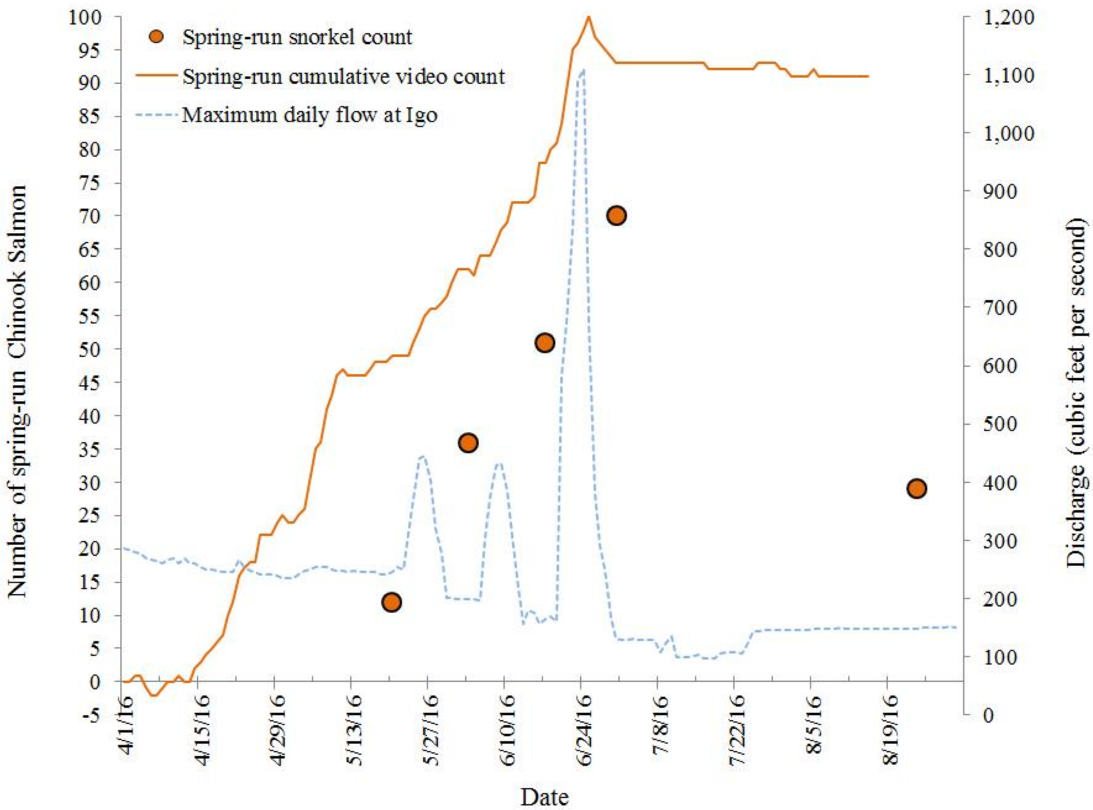

Figure 4. Spring-run Chinook Salmon cumulative daily passage at the Clear Creek video station and maximum daily flow from the USGS gauging station at Igo (IGO) during the migration period, 2016. Spring-run snorkel survey counts from before and after each pulse flow, and during the August Index survey are shown for comparison. Video passage data is provisional as of Sept 21, 2016.

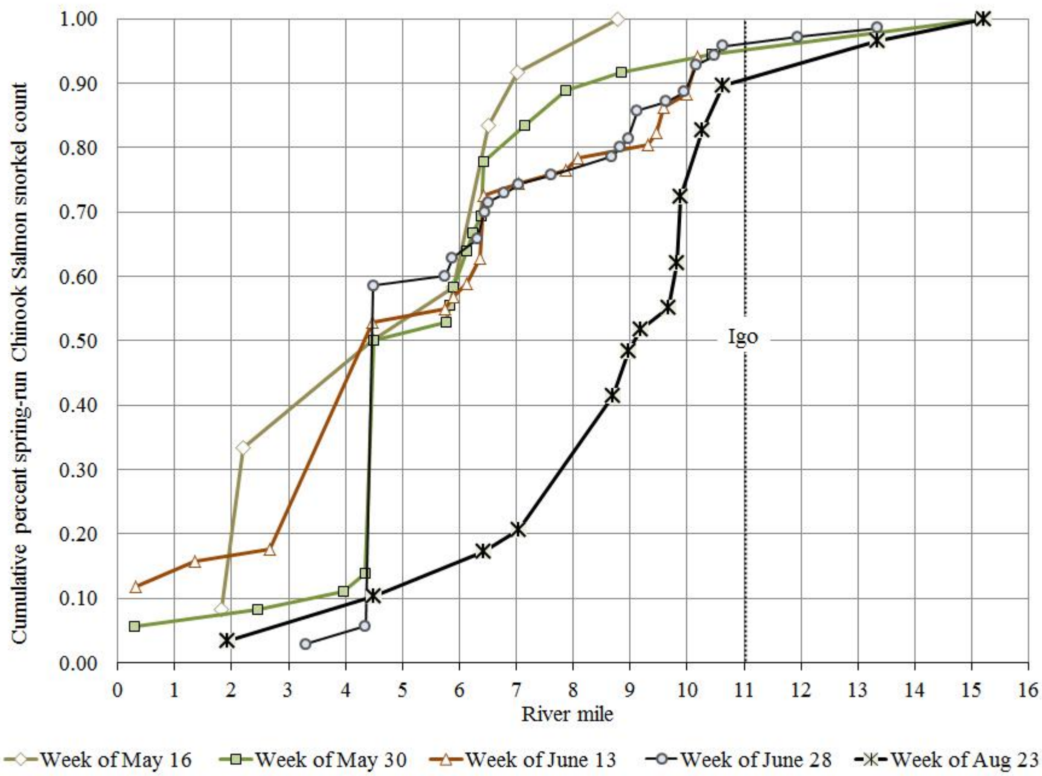

Figure 5. Distribution of holding spring-run Chinook Salmon during snorkel surveys, Clear Creek 2016. Surveys in May and June were conducted before and after each pulse flow. The August survey is the spring-run index. The USGS gauging station at Igo is the temperature compliance point.

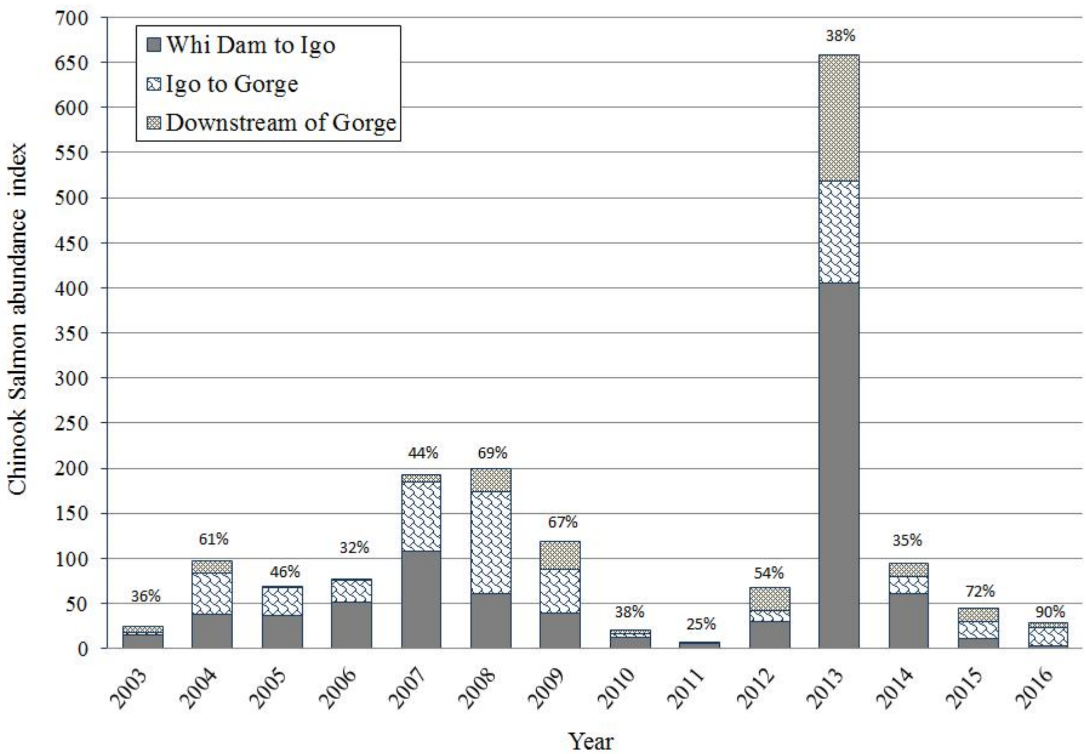

Figure 6. Adult spring-run Chinook Salmon August Index, 2003-2016. Stacked bars represent holding distribution from Whiskeytown Dam (river mile 18.3) to the USGS Igo gauging station (IGO) (river mile 11.0), IGO to the Gorge Cascade (river mile 6.5), and downstream of the Gorge Cascade. Percent over each annual stacked bar is the distribution of the August Index downstream of IGO.

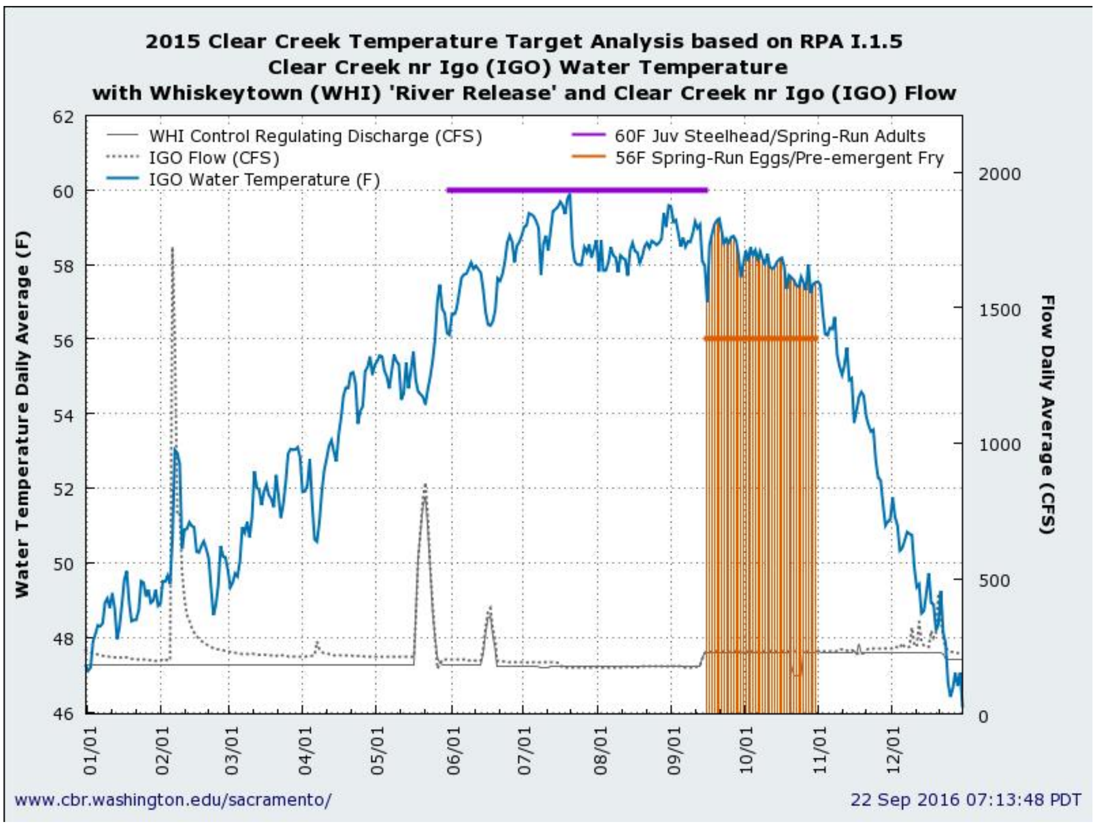

Figure 7. 2015 release at Whiskeytown, discharge at IGO, and daily average water temperature at IGO compared to RPA I.1.5 criteria for holding (June 1 to Sept 14) and for spawning (Sept 15 to October 31) http://www.cbr.washington.edu/sacramento/data/tc_clear_RPAI.1.5.html.

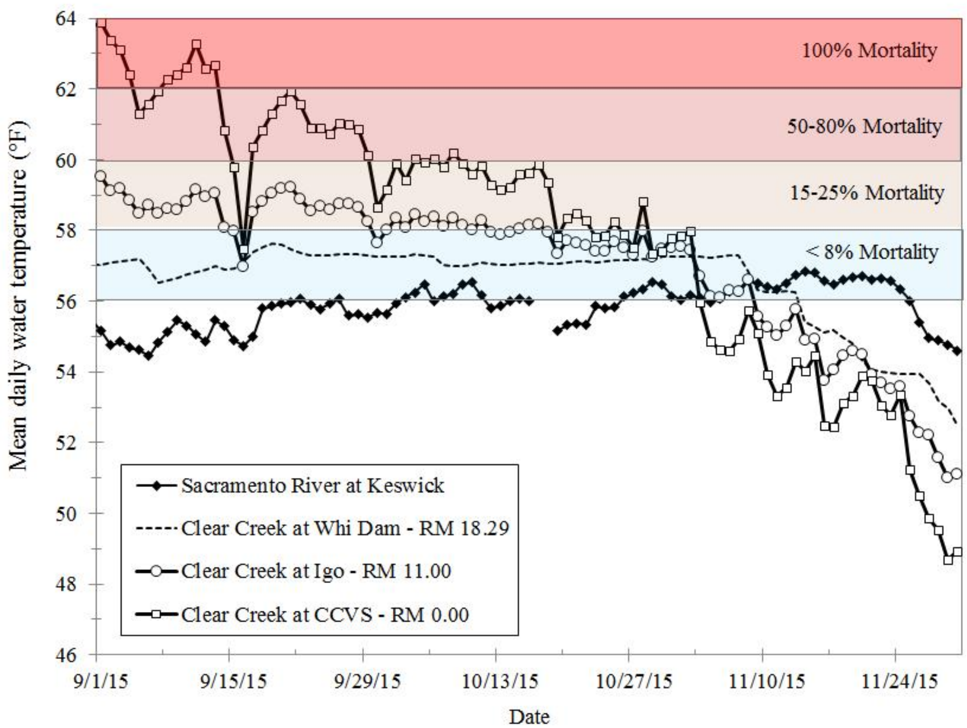

Figure 7. Mean daily water temperatures in Clear Creek and the Sacramento River at Keswick during the spring-run Chinook Salmon spawning period in 2015. Colored bands indicate potential mortality levels to incubating embryos due to elevated water temperatures.

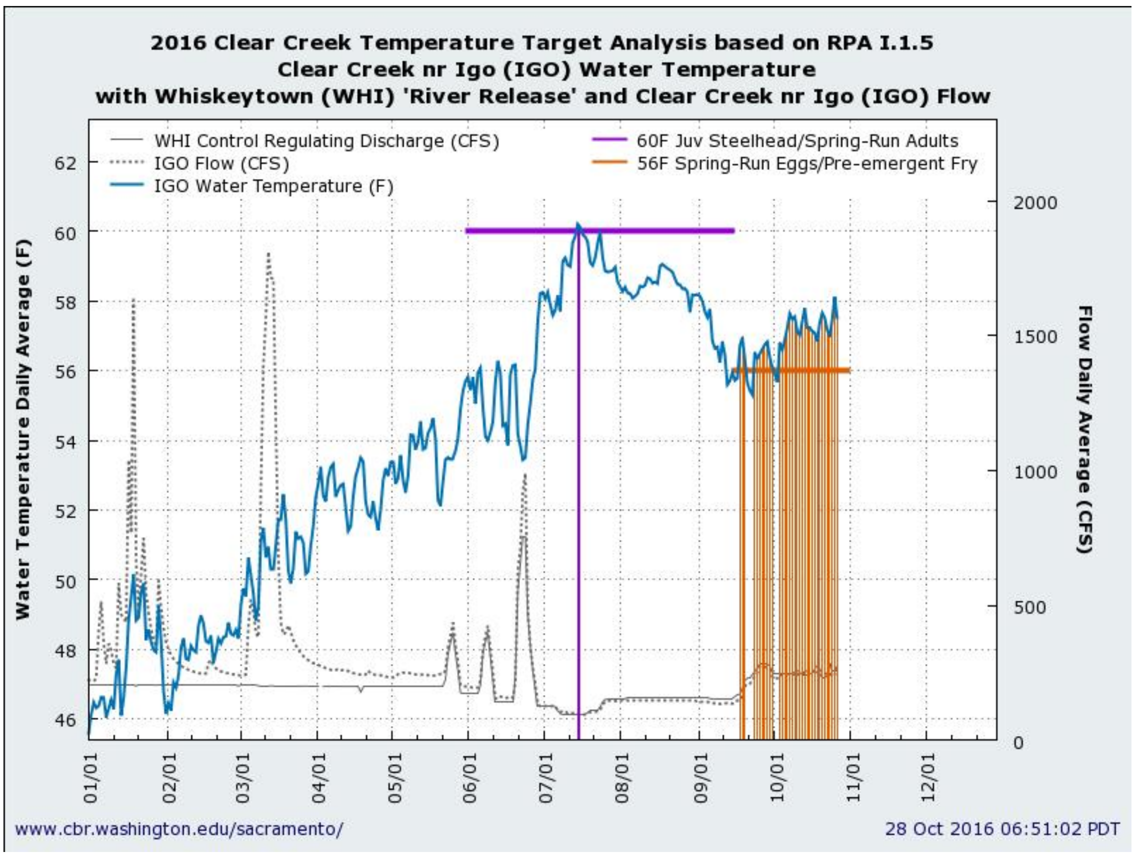

Figure 8. 2016 release at Whiskeytown, discharge at IGO, and daily average water temperature at IGO compared to RPA I.1.5 criteria for holding (June 1 to September 14) and for spawning (September 15 to October 31). Data as of 10/28/2016 From: http://www.cbr.washington.edu/sacramento/data/tc_clear_RPAI.1.5.html

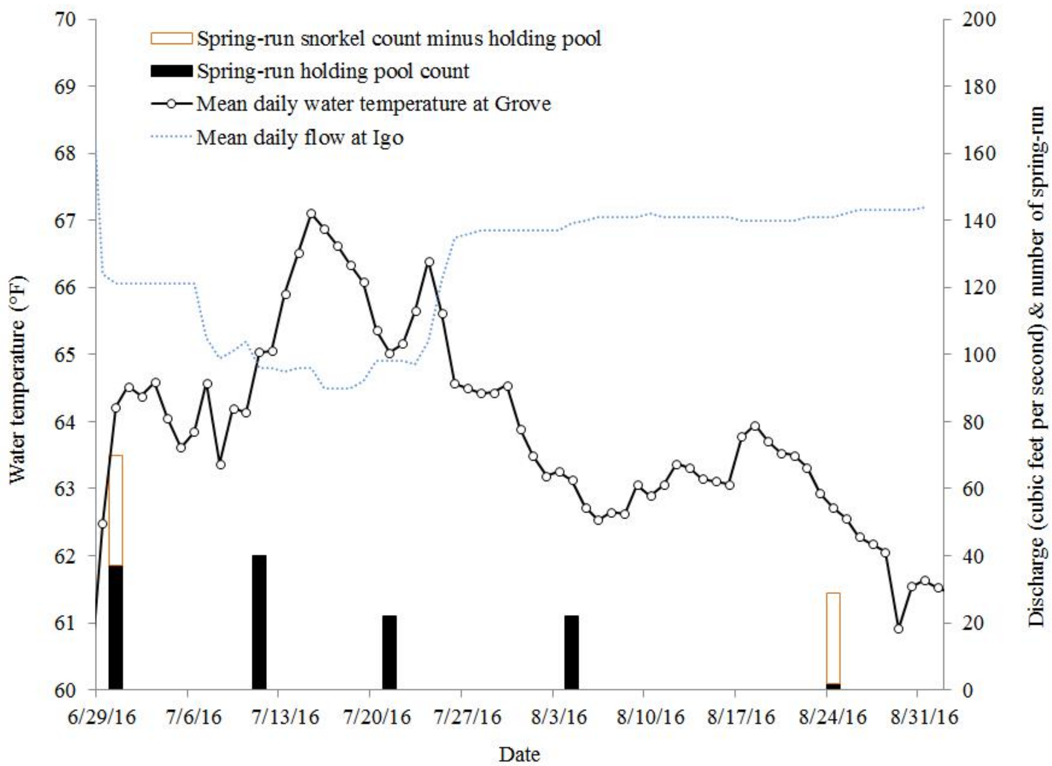

Figure 9. Spring-run Chinook Salmon snorkel survey count after the final pulse flow, and August Index count. For each survey, proportion of counts in North State Pool at river mile 4.49 is shown. In addition, three snorkel surveys were conducted in the holding pool only during the period when the flows were decreased to lower the water temperature in the lower watershed to order to encourage upstream migration of spring-run. Mean daily flows at Igo gauging station, and mean daily water temperatures at the closest water temperature monitoring station to the holding pool are shown to display the flow and associated water temperature changes.