2018 Feather River Hatchery Chinook Salmon and Steelhead Spawning and Release Protocol

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Background:

The Feather River Hatchery (FRH) conducts two artificial propagation programs for Central Valley (CV) Chinook salmon: CV spring-run and CV fall-run and one artificial propagation program for CV steelhead. CV spring-run Chinook are listed as threatened under both the California Endangered Species Act and the Federal Endangered Species Act. CV fall-run Chinook provide for economically important commercial fisheries as well as popular sport fisheries in the ocean and inland. CV steelhead are listed as threatened under the Federal Endangered Species Act.

The primary purpose of the spring-run program is to conserve and promote phenotypic spring-run Chinook salmon in the Feather River. A coequal purpose of the program is to mitigate for the loss of spawning and rearing habitat due to construction of Oroville Dam. Additionally, due to the threatened status of spring-run it is crucial that hatchery operations are conducted in a way that minimizes impacts to natural spawning populations of CV spring-run populations, including those in Mill, Deer, Clear, and Butte Creeks.

Due to past hatchery spawning practices and overlap in spawning habitat in-river, spring and fall runs on the Feather River are considered introgressed. In 2012, the California Hatchery Scientific Review Group (HSRG) released the California Hatchery Review Report that establishes specific recommendations for all California hatcheries, including the FRH. (See Attachment A) The report states, “Most hatcheries were producing fish for harvest primarily to mitigate for past habitat loss (rather than for conservation of at- risk populations) and were not taking into account the effects of their programs on naturally spawning populations (CA HSRG 2012). With numerous species listed as threatened or endangered under the Endangered Species Act, Congress identified salmon conservation as a high priority.” The document further states, “The goal of this hatchery program review initiative is to ensure that hatchery programs are managed and operated to meet one or both of the primary purposes for hatcheries:

- Helping recover and conserve naturally spawning salmon and steelhead populations, and
- Supporting sustainable fisheries with little or no deleterious consequence to natural populations.”

Since 2012, spawning practices at FRH have been refined and reviewed annually to further meet HSRG recommendations and to specifically minimize introgression between runs on the Feather River.

The primary purposes of the fall-run program is to mitigate for the loss of spawning and rearing habitat due to construction of Oroville Dam and support river and ocean fisheries. In years when funding and broodstock allow, FRH produces additional fall-run Chinook for Ocean fishery enhancement. The enhancement program is funded by the commercial salmon trollers through the Salmon Stamp program and Fish and Game non-dedicated preservation fund. Additionally, fall-run are produced and triploided for a small cold-water fishery in Lake Oroville for DWR’s FERC program as well as the statewide Inland Chinook salmon program.

The FRH steelhead program is implemented as an integrated hatchery mitigation program for loss of spawning and rearing habitat due to construction of Oroville Dam. This is an integrated production program and provides recreational fishing opportunities. Both hatchery and natural

origin steelhead from the Feather River are considered part of the Central Valley steelhead ESU (NOAA 2006).

Chinook salmon

1.0 Spring-run Chinook Salmon Broodstock Collection and Spawning Protocol:

1.1 Broodstock Identification

Only early-arriving Chinook salmon (phenotypic spring-run) are used as broodstock for the spring-run Chinook program. Typically, fish ascending the fish ladder April through June are trapped, tagged, and a hatchery or natural-origin determination is recorded. The trapping and tagging process typically begins on or about April 1 and continues through June. The process consists of double tagging fish with two sequentially numbered and color-coded Hallprint Dart tags on either side of the dorsal fin. Number sequences are unique to each fish. Water flow into the FRH ladder was reduced on June 29, 2018, to prevent new fish from entering the ladder. Salmon in the ladder prior to June 29 were tagged until July 5. Any mortality observed during the broodstock tagging was documented and heads removed for Coded Wire Tag (CWT) extraction from fish with an adipose fin-clip.

During spring of 2018, 3206 salmon where tagged. (Table 1). See table 2 for comparison to previous years.

Table 1- 2018 FRH Spring-run Broodstock Tagging

	5/21/2018	5/24/2018	5/29/2018	5/31/2018	6/4/2018	6/7/2018	6/11/2018	6/14/2018	6/18/2018	6/25/2018	7/2/2018	7/5/2018	Totals
Total # Tagged	543	330	485	197	360	82	184	364	217	282	134	28	3206
Recaps	NA	13	92	54	88	29	56	109	94	185	31	9	760
Wild	29	22	30	15	44	10	45	79	43	95	34	11	457
Morts	0	0	1	0	0	0	0	0	0	0	1	0	2
Single tags	20	6	5	2	7	2	3	5	2	6	0	0	58
Acoustic tags	0	14	0	0	0	0	0	0	0	0	0	0	14
Jacks	12	11	9	9	26	0	32	74	36	64	31	6	310

Table 2- Spring-run broodstock tagging for returning adults collected in 2004-2018.

Total Spring Run Hallprint Tagged	Year
3650	2004
6021	2005
17438	2006
9755	2007
1915	2008
1462	2009
3502	2010
6023	2011
7494	2012
20057	2013
7289	2014
5355	2015
2917	2016
762	2017
3206	2018
6456	Average

* 2004 was the first year that juvenile spring-run were tagged at a 100% rate.
This likely influenced the adipose fin-clip rate in returning adults for the subsequent four years.

1.2 Broodstock collection and spawning

For spring-run spawning, the FRH ladder will open Friday, September 14, 2018. Fish entering the hatchery are sorted and all Hallprint tagged SRCS broodstock are separated from all other Chinook. Initially, male and female SRCS will be separated in the alleyways on day of spawn, until enough pairs are obtained for spawning. Fish that cannot be spawned on that day will be placed into round tanks for subsequent spawning. Females and males will be sorted and held separately to reduce stress and mortality in the female broodstock. Spawning will occur whenever sufficient numbers of ripe spring-run broodstock (Hallprint Dart tagged fish) have accumulated in the round tanks of roughly equal sex ratio. If it is determined by hatchery staff that spring-run spawning can be conducted, hatchery staff will notify all individuals involved in tissue and scale collection, and CWT recovery as to when spawning will commence. One round tank will be reserved to hold incoming fall-run for the Inland Chinook program. All Chinook entering the hatchery during the spring-run spawning period that are excess to the Inland Program goals are excised and counted. No fish are returned to the river in order to reduce hatchery impacts to the natural spawners and to assure fish will not be counted more than once. Spring-run broodstock collection and spawning will start September 17, 2018 and continue through September 28, 2018.

Spring Run Chinook Spawning Procedures:

1. Fish are anesthetized using CO_2 then brought up on the lift and sorted by sex onto the table.

    a. As fish are pulled off the table to spawn, the front of house (FOH) data recorder records sex, indicates grilse or adult, adipose fin-clip status, and records the unique Hallprint tag number onto a data card. The data card is then attached to the egg tub to track the parentage of the eggs in each tub.

    b. Grilse are incorporated at 2%.

    c. Fall-run Chinook are spawned using a true 1 male: 1 female ratio. FRH staff will attempt to eliminate the reuse of males as much as possible. However, if males are used multiple times, they are treated as new fish each time they are spawned. This is recorded and highlighted on the associated data card for each tub and number is recorded for hatchery files.

    d. If possible, eggs will not be combined after fertilization, but if it is necessary to combine after fertilization, both data cards are attached to the tub of combined eggs. There is a maximum of two females' eggs combined in a tub to avoid confusion and data recording errors.

2. Once a tub is filled with fertilized eggs, the FOH data recorder will attach the data card(s) to the tub then it will be taken to the egg room by an egg runner. Egg weight (ounces) will be recorded on the data cards and data sheets. The data cards will be removed from the tub and given to the back of house (BOH) data recorder at the time the eggs are emptied into an incubation tray. Egg tubs will be rinsed thoroughly with UV water prior to being reused.

    a. To ensure maximum survival in 2018, eggs will be counted at the collection stage, after water hardening.
        i. A 2oz sample will be taken from each egg tub that are taken to BOH. The eggs will be water hardened and counted at end of day to determine eggs per ounce and total ounces taken for the day.

    b. If some eggs in the tub are overripe, all the eggs in the tub will be discarded, and the BOH data recorder will check the 'Discarded' box on the data card. The stack and tray information will be left blank on the data card.

3. When the tub of fertilized eggs is emptied into an incubator tray, the stack, tray number, and section within the tray will be recorded on the data card by the BOH data recorder.

    a. Fertilized eggs will be drained of ovarian fluid and milt in a colander and then hardened in incubation trays using 4 oz. iodophor for disinfection. Further information on egg incubation procedures can be found in FRH Standard Operating Procedure (SOP) 001 Egg Culture.

4. When a data card is filled and complete, it will be grouped with the other cards from the day, scanned and sent to Ocean Salmon Project (OSP) for entry into a database. All data sheets will be compiled in the FRH office and entered into an excel spreadsheet.

5. All fish carcasses will be immediately brought to the CWT sampling station. Fish Hallprint tag ID tag numbers from mating pairs will be recorded and removed, and fish prepared for genetic tissue, CWT, and scale sampling.

6. Broodstock collection will continue until September 28, 2018. Any fish with a Hallprint tag returning after September 28, 2018 will be euthanized and not used for broodstock.

1.3 San Joaquin Collection

After FRH spring-run egg collection goals determined to be met, eggs will be collected for the San Joaquin River Restoration Program. The first collection is for broodstock. To achieve sufficient genetic variability, eggs are collected from the spring run trays ensuring that at least 350 paired crosses are used for a total of 5,470 eggs. Data from each pair will be collected for the San Joaquin program and virology samples will be taken for IHN. This will allow rejection of a significant number of crosses and yet provide substantial genetic variability in the future broodstock population.

Egg collection for the San Joaquin River Restoration Program will be secondary to collection for the spring run Chinook program for the FRH (Attachment B) and will be dependent on time constraints and available broodstock.

2.0 Fall-run Chinook Broodstock Collection and Spawning Protocol

2.1 Broodstock collection and spawning

Fall-run spawning will commence on October 10, 2018. All salmon entering the hatchery on or after this date that does not carry a Hallprint tag is considered a candidate for inclusion in the fall-run broodstock. Broodstock collection and spawning is conducted in a manner that represents fish arriving from throughout the fall-run spawning period.

During fall-run spawning, broodstock can include all salmon (adipose fin intact and fin-clipped) except Hallprint tagged salmon. Spawning and egg collection will follow the egg collection model described in Table 4 unless run timing or numbers of fish are insufficient. Fall-run spawning includes both adipose fin intact and fin-clipped fish in the broodstock, CWT analysis will be used to identify stacks and trays with spring-run contribution. Review of CWT data on spring-run contribution and other hatchery contribution rates into fall-run trays in near real-time to determine the need for culling.

Fall-run Chinook will be collected and held in round tanks until needed for spawning. Fall-run Chinook are spawned using a true 1 male: 1 female ratio. Reuse of males will not occur and may result in not meeting egg collection goals. If the daily egg take goal is not met, the remainder of eggs will be added to the target for the next day. Grisles will be incorporated at no more than 2%.

The head will be removed from any adipose clipped fish for coded-wire tag (CWT) analysis. CWT analysis is used to examine contribution rates of hatchery-origin strays from other CV hatcheries into individual egg trays. Egg trays with confirmed out-of-basin fish will

be discarded. The combined mitigation (6 million) and enhancement program (1 million) production goal is 7 million juveniles. No more than 14.5 million green eggs will be collected throughout the run. This target allows for culling of out-of-basin strays, as well as culling at the eyed stage to meet the production goal. The high number of green eggs collected also guards against unforeseen mortality or disease outbreaks. Eggs will be collected to represent the spectrum of the run to meet production goals according to the chart provided (Figure 2).

Fall run Chinook Salmon Spawning Procedures:

1. Fish will be anesthetized using CO_2, lifted into the hatchery, sorted on the table by sex. Each **ad-clipped** fish will be marked with a reusable tag (5 ¾ inch safety pin with uniquely numbered tag attached to the lower jaw or operculum).

2. As fish are pulled off the table to spawn, the front of house (FOH) data recorder will record sex, grisle or adult based on total length, and ad-clip status of each spawned fish on the data card. For non-clipped fish, a line will be drawn through the 'ID Number' field. For ad-clipped fish, the spawner will read the tag ID number to the data recorder. Completed data cards will be attached to the egg tub. Each tub will have at least one and no more than two data cards associated with it.

    a. Fall-run Chinook are spawned using a true 1 male: 1 female ratio. Reuse of males will not occur and may result in not meeting egg collection goals.

    b. If two tubs of eggs are combined after fertilization, both data cards will be attached to the egg tub of combined eggs. A maximum of two females can be combined in a tub to avoid confusion and data recording errors.

3. Once a tub is filled with fertilized eggs, the data card (s) will be attached to the tub by the FOH data recorder. The tub will then be brought back to the egg room by the egg runner.

4. When the tub is emptied into an egg tray, the BOH data recorder will remove the data card and record the stack and tray number. If the tub is split between two trays, the data recorder will record the numbers of both stacks and trays the eggs went into. The emptied tub will be rinsed thoroughly with UV water and sent back to the spawning room to be used again.

    a. If some overripe eggs are observed in the tub, the whole tub will be discarded and the BOH data recorder will check the 'Discarded' box on the data card. The stack and tray fields are left blank on the data card.

    b. Fertilized eggs will be drained of ovarian fluid and milt in a colander and placed into incubation trays with 4 oz. iodophor for disinfection. Further information on egg incubation procedures can be found in FRH SOP 001 Egg Culture.

5. Completed data cards will be grouped with the rest of the daily cards, scanned and sent to Ocean Salmon Project (OSP) for entry into database.

6. Carcasses of spawned fish will be brought to the CWT sampling station. Fish ID numbers will be recorded, ID tags removed, and the fish prepared for CWT and scale sampling.

7. After all data and samples are collected, carcasses suitable for human consumption will processed and distribution to non- profit and charitable organizations. Fish not suitable for consumption will be sent to rendering.

2.2 **Lake Oroville Coldwater Fishery and Inland Collection**

Adult fall-run Chinook will be held in two of the four round tanks during the spring-run spawning period from September 17, 2018 through September 28, 2018 to be used as broodstock for the Lake Oroville cold-water fishery and the statewide Inland Chinook program. The inland Chinook collection will start October 1, 2018 and run through October 8, 2018. The daily goal for inland collection will be no more than 450,000 fall run Chinook eggs per day.

Eggs intended for the Lake Oroville cold-water fishery program and a portion of the eggs intended for the statewide inland Chinook program will be triploided then isolated in the FRH Inland Hatchery building following procedures outlined in FRH SOP 015. Approximately 1.2 million green eggs will be incubated in the FRH inland hatchery building. Once eyed, approximately 250,000 eggs will be kept at the FRH inland building for the Lake Oroville inland Chinook program. All remaining eyed eggs will be transferred to the Silverado Fish Base (SFB) to continue incubation to hatch and rearing prior to release. An additional 1.0 million eggs will be collected for the statewide inland Chinook program. The eggs will be fertilized, triploided, then disinfected for 15 minutes in 100 ppm iodophor in buckets. After disinfection eggs will be enumerated and water hardened overnight in UV water in vertical incubation stacks at 80 ounces per tray. The next morning after eggs are water hardened they will be enumerated, packed in egg shipping containers and transferred to SFB to be incubated and reared prior to release.

All adult Chinook salmon remaining at the hatchery after Monday, October 8th will be excised on Tuesday, October 9th before the beginning of fall-run broodstock collection.

3.0 Chinook Salmon Production Goals:

During the 2018/2019 spawning and rearing season priority is given to improving temporal separation between spring and fall runs.
The current production goals for release or transfer from FRH are as follows:

Spring-Run Chinook Salmon Conservation:	Up to 2 million smolts
Fall-Run Chinook Salmon Lake Oroville:	Up to 125,000 yearlings
Fall-Run Chinook Statewide Inland:	Up to 705,000 fingerlings
Fall-Run Chinook Salmon Mitigation:	Up to 6 million smolts
Fall-Run Chinook Salmon Enhancement:	Up to 1 million post smolts*

*Post smolts range in size between 30-45 fish per pound

For both spring and fall- runs, assumed survival from green to eyed egg stage is approximately 85 percent between green and eyed egg stage and 92 percent for eyed egg to ponding of fish. Total green egg take for fall-run is approximately 2,500,000 over eyed egg stage goals. This egg take buffer over actual production goals allows for potential mortality in egg trays and culling of trays if necessary. Culling will be done so that the last tally of eyed eggs prior to ponding fish represents no more than 12-15% over the actual production goals for release. When culling, an equal proportion of eggs will be removed from each tray in order to reach the minimum needed egg take and to keep similar sized family groups. This will again provide a buffer against any potential mortality while fish are in the raceways.

Survival of eggs from green to hatch for the inland program is assumed to be significantly less than those of the fall and spring run production due to the triploiding process as well as the additional stress caused by transporting green eggs from FRH to Silverado Fish Base (SFB) for quarantine.

Because this is still a new process at FRH and for CDFW the assumed green to hatch survival will be set at 50%. Currently the inland program is limited by incubation space, therefore the number of green eggs collected will maximize the available space, however a 50% loss rate will likely leave the inland program short of its fish planting goal. Loss rates will be tracked for eggs held at Silverado, as well as those shipped green to SFB to help better refine future production targets.

Table 3- Spring-run Eyed Egg Goal

Feather River Hatchery 2018																	
Spring-run Eyed Egg Goal			2,000,000														
Date	Status	Lot #	# of females (assume one spawning pair per incubation tray)	Actual Green Eggs Collection (assume 4,500 eggs/femal	Predicted Percent culling rate	Predicted Egg Collection after culling	Actual Percent culling rate	Actual Egg Collection after culling	Assumed 80% Survival to eyed after culling based on Predicted	Assumed 85% Survival to eyed after culling	90% Survival to eyed after culling	Assumed 80% Survival to eyed after culling based on actual Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column L Predicted Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column M Predicted Egg	Assumed 95% Survival from eyed to ponded fish based on Predicted Egg collection	Actual estimat e of ponded fish
9/17	Completed	1	67	301,500	1%	298,485			238,788	253,712	253,712		228,341	228,341	241,027	
*	Completed	2	133	598,500	1%	592,515			474,012	503,638	503,638		453,274	453,274	478,456	
*	Expected	3	222	999,000	1%	989,010			791,208	840,659	840,659		756,593	756,593	798,626	
*	Expected	4	178	801,000	1%	792,990			634,392	674,042	674,042		606,637	606,637	640,339	
9/28	Expected	5	133	598,500	1%	592,515			474,012	503,638	503,638		453,274	453,274	478,456	
	Totals		733	3,298,500		3,265,515		0	2,612,412	2,775,688	2,775,688		2,498,119	2,498,119	2,636,903	
*	Specific spawning dates and lot sizes are variable and depend on availability of ripe fish.															

Figure 1- 2018 Predicted SRCS Egg Collection

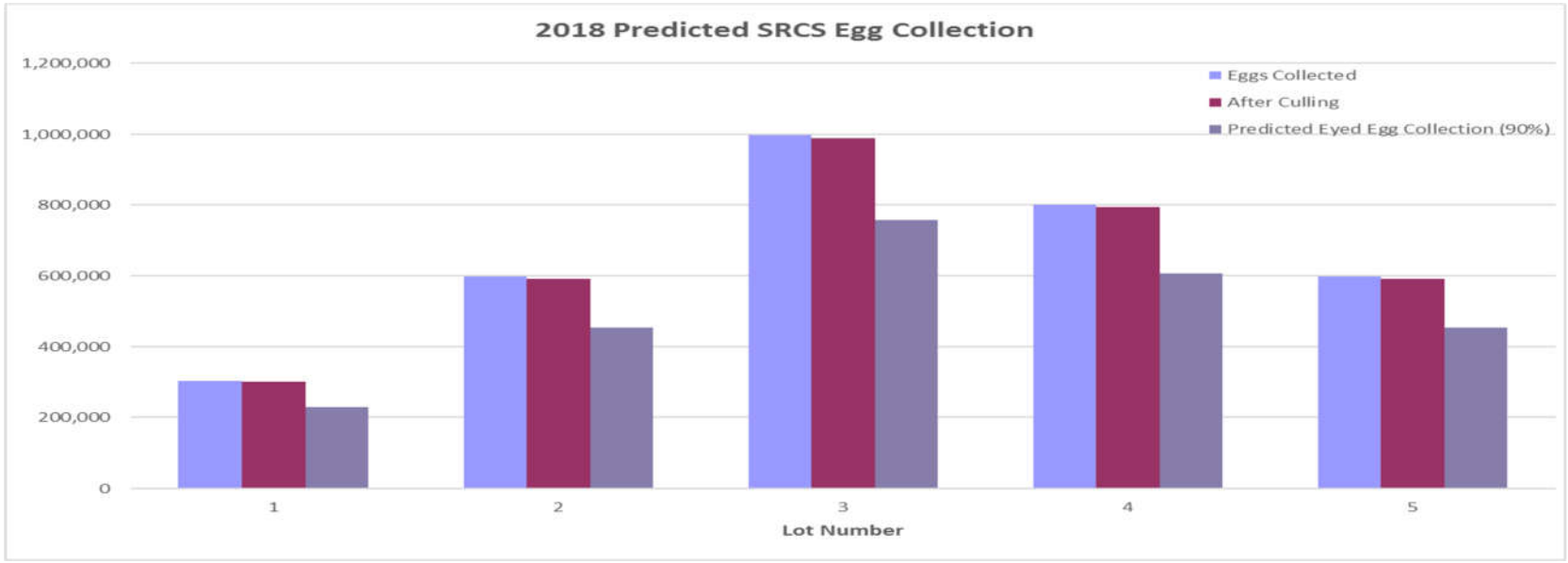
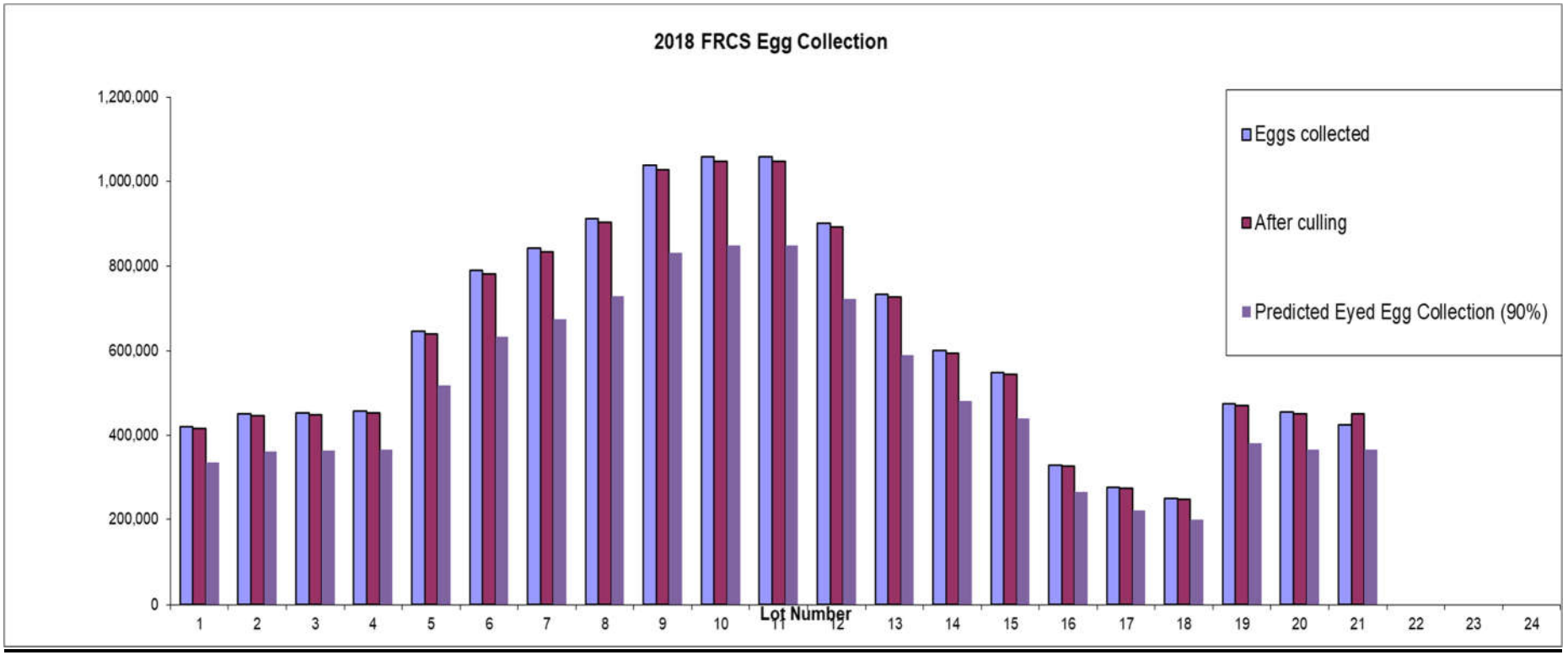


Table 5- FRCS Egg Collection

Feather River Hatchery 2018															
Fall-run Eyed Egg 8,000,000 (6,000,000 mitigation & 2,000,000 enhancement)															
Date	Status	Expected Green Eggs Collection (assumes 4500 eggs/female)	Actual Green Eggs Collection	Predicted Percent culling rate	Predicted Egg Collection after culling	Actual Percent culling rate	Actual Egg Collection after culling	Assumed 80% Survival to eyed after culling based on Predicted Egg collection	Assumed 85% Survival to eyed after culling	90% Survival to eyed after culling	Assumed 80% Survival to eyed after culling based on actual Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column L Predicted Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column M Predicted Egg collection	Assumed 95% Survival from eyed to ponded fish based on Predicted Egg collection	Actual estimate of ponded fish
10/10	Expected	419,424		1%	415,230			332,184	352,945	373,707	0	317,651	336,336	355,021	
10/12	Expected	451,000		1%	446,490			357,192	379,517	401,841	0	341,565	361,657	381,749	
10/15	Expected	453,000		1%	448,470			358,776	381,200	403,623	0	343,080	363,261	383,442	
10/16	Expected	457,045		1%	452,475			361,980	384,603	407,227	0	346,143	366,504	386,866	
10/17	Expected	646,000		1%	639,540			511,632	543,609	575,586	0	489,248	518,027	546,807	
10/18	Expected	790,000		1%	782,100			625,680	664,785	703,890	0	598,307	633,501	668,696	
10/19	Expected	842,880		1%	834,451			667,561	709,284	751,006	0	638,355	675,905	713,456	
10/22	Expected	911,800		1%	902,682			722,146	767,280	812,414	0	690,552	731,172	771,793	
10/23	Expected	1,036,840		1%	1,026,472			821,177	872,501	923,824	0	785,251	831,442	877,633	
10/24	Expected	1,058,800		1%	1,048,212			838,570	890,980	943,391	0	801,882	849,052	896,221	
10/25	Expected	1,058,800		1%	1,048,212			838,570	890,980	943,391	0	801,882	849,052	896,221	
10/26	Expected	901,800		1%	892,782			714,226	758,865	803,504	0	682,978	723,153	763,329	
10/29	Expected	734,400		1%	727,056			581,645	617,998	654,350	0	556,198	588,915	621,633	
10/30	Expected	600,580		1%	594,574			475,659	505,388	535,117	0	454,849	481,605	508,361	
10/31	Expected	548,800		1%	543,312			434,650	461,815	488,981	0	415,634	440,083	464,532	
11/1	Expected	330,000		1%	326,700			261,360	277,695	294,030	0	249,926	264,627	279,329	
11/2	Expected	275,520		1%	272,765			218,212	231,850	245,488	0	208,665	220,939	233,214	
11/5	Expected	250,000		1%	247,500			198,000	210,375	222,750	0	189,338	200,475	211,613	
11/6	Expected	474,985		1%	470,235			376,188	399,700	423,212	0	359,730	380,890	402,051	
11/9	Expected	455,586		1%	451,030			360,824	383,376	405,927	0	345,038	365,334	385,631	
11/14		423,985		1%	451,030			360,824	383,376	405,927	0	345,038	365,334	385,631	
	Totals	13,121,245			13,021,318		0	10,417,054	11,068,120	11,719,186	0	9,961,308	10,547,267	11,133,226	

Figure 3- 2018 Predicted FRCS Egg Collection



4.0 Chinook Feeding Strategy

When 90-100% of the fish in incubation stacks have buttoned-up, they will be transferred to outdoor concrete raceways. Fry will be hand fed Bio-Oregon Bio-Pro 2, or Bio-Supreme diet, to satiation at each feeding, 4-8 times a day depending on age and size. All spring run will be on Bio-Pro 2 until release. 1.0 million Enhancement fall run and 1.0 million mitigation fall run designated for San Pablo Bay net pens will be switched to Bio-Supreme transfer diet at least 6 weeks prior to release. Bio-supreme transfer diet has been specially formulated to help fish ease osmotic regulation when transferring to salt water. Recent studies shown return rates up to 42% higher than control in Central Valley Chinook. Fish that are scheduled to be released at a larger size, such as the Salmon Stamp Ocean Enhancement fish, may be fed transfer diet for up to 6 weeks. Medicated and antibiotic feeds will be used if necessary as prescribed by CDFW pathologists.

Fish size (fish/lb.)	Feed Size	Fish Food Type	Fed Times a day
3000 to 570	#0	Bio-Pro	7-8
570 to 300	#1	Bio-Pro	7-8
300 to 150	#2	Bio-Pro	4-6
350 to 150	#2	Bio-Pro	4-6
150 to 60	#3	Bio-Pro	4-6
140 to 60	1.2	Bio-Supreme	4-6
60 to 45	1.2	Bio-Supreme	4-6

5.0Chinook Release Strategy

5.1 Spring-run Release Approach

In 2019, will somewhat replicate the release strategy that was implemented in 2016. In 2017, only one release was made due to low production of SRCS. The SRCS will be split into 6 groups of 334,000 fish with each group containing a unique Coded Wire Tag (CWT). The first release of SRCS will be the experimental storm event “early” release. These two groups of 334K fish each will be released on the climbing limb of a storm event as soon after tagging as possible with one group going to Boyd’s pump and the other going to Gridley. There is no target size for these fish, however they will need to be at least 120/lb to go through the auto fish tagging trailer. The second release will replicate previous “early” releases and will be in late-March at Boyd’s pump and Gridley. The target release weight is a minimum of 90 fish/lb. The third release will be the “late” release, scheduled for mid to late-April at Boyds pump and Gridley.. The target release weight is a minimum of 60 fish/lb. The early releases are being implemented to evaluate survival of spring-run released in-river at a smaller size than past releases (past releases have been approximately 60 fish/lb) and in high flow and turbidity events. Each set of releases will use two in-river release sites (Gridley and Boyd’s Pump Boat Launch) to evaluate differences in survival and stray rate with release location.

Sentinel hatchery fish will be used during the releases and water quality samples will be collected to continue monitoring for the prevalence and severity of *Ceratonova shasta* and its effect on Feather River Chinook salmon.

Table 5. Spring-run Release Strategy

Date	Location	# of Fish	Fish/lb.	With CWT and Mark
Early March	Gridley	334,000	>120	100% Ad Clip
Early March	Boyd's pump	334,000	>120	100% Ad Clip
Late March	Gridley	334,000	90	100% Ad Clip
Late March	Boyd's	334,000	90	100% Ad Clip
Mid-April	Gridley	334,000	60	100% Ad Clip
Mid-April	Boyd's	334,000	60	100% Ad Clip

Criteria and Contingencies In coordination with National Marine Fisheries Service (NMFS), CDFW has developed the following criteria and triggers that will be used to inform decisions on the release strategy to be implemented in 2018/2019. These criteria and triggers were developed based on review of water temperature, river flow, Delta Cross Channel Gate operations. The criteria identified below are designed to minimize the risk of exposing FRH produced FRCS salmon to river conditions that could result in extremely low survival. Each of the criteria indicated below are intended to be independent of the others, meaning that if any one or more of the criteria are anticipated to be met then FRH produced FRCS salmon should be transported to the acclimation net pens for release into San Pablo Bay. If none of the triggers are forecast to be met, then juveniles will be released into Feather River, as describe above in section 5.2.

Delta Cross-channel Gates operations – Survival of juvenile salmon is significantly reduced when gates are open and increased numbers of fish are diverted into the interior Delta.

- Cross-channel gates are forecast* to be open within 21 days** days of the date when the hatchery salmon are ready to be released.

Water Temperature – Increased water temperatures above 70 degrees has been shown to be detrimental to juvenile survival.

- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Verona within 21** days of the date when the hatchery salmon are ready to be released.
- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Freeport within 21** days of the date when the hatchery salmon are ready to be released.

Flow – Decreased flows in the Sacramento River lead to significantly reduced survival of juvenile salmon because of reduced travel times exposing the fish to increased predation and increased risk of diversion into the interior Delta where survival is significantly reduced.

• A Sacramento River flow at Verona of less than 4,000 cfs is forecast* to occur within 21**
days of the date when the hatchery salmon are ready to be released.
• A Sacramento River Flow of less than 6,000 cfs at Freeport is forecast to occur within 21** days of the date when the hatchery salmon are ready to be released.
• Delta Outflow is forecast* to be less than 3,000 cfs within 21** days of the date when the
hatchery salmon are ready to be released.

If during any of these assessments, existing/predicted conditions are expected to meet the criteria triggering consideration of the alternative release strategy. Alternative release strategy would be an early release of all SRCS into the Feather River at Boyd's pump.

5.1 Fall-run Release Approach

One million juvenile fall-run Chinook salmon juveniles (mitigation salmon) will be release into the Feather River in late-April. An in-river release of one million juvenile fall-run Chinook salmon (FRCS) from the mitigation production will allow assessment of the behavior, condition, and survival of salmon as well as their return and stray rates of an in river release. In 2019, the fall-run will be marked at a 25% rate. All fish will be loaded and transported in accordance with FRH SOP's 007 through 013

Table 6. Fall-run In-River Release Strategy

Date	Location	Fish/lb.	Total FRCS	With CWT and Mark
4/27/2018	Boyd's Pump	60	1,000,000	25% Ad Clip

Criteria and Contingencies In coordination with the National Marine Fisheries Service (NMFS) CDFW has developed the following criteria and triggers that will be used to inform decisions on the release strategy to be implemented in 2017. These criteria and triggers were developed based on review of water temperature, river flow, Delta Cross Channel Gate operations. The criteria identified below are designed to minimize the risk of exposing FRH produced FRCS salmon to river conditions that could result in extremely low survival. Each of the criteria indicated below are intended to be independent of the others, meaning that if any one or more of the criteria are anticipated to be met then FRH produced FRCS salmon should be transported to the acclimation net pens for release into San Pablo Bay. If none of the triggers are forecast to be met, then juveniles will be released into Feather River, as describe above in section 4.2.

Delta Cross-channel Gates operations – Survival of juvenile salmon is significantly reduced when gates are open and increased numbers of fish are diverted into the interior Delta.

• Cross-channel gates are forecast* to be open within 21 days** days of the date when the
hatchery salmon are ready to be released.

Water Temperature – Increased water temperatures above 70 degrees has been shown to be detrimental to juvenile survival.

- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Verona within 21** days of the date when the hatchery salmon are ready to be released.
- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Freeport within 21** days of the date when the hatchery salmon are ready to be released.

Flow – Decreased flows in the Sacramento River lead to significantly reduced survival of juvenile salmon because of reduced travel times exposing the fish to increased predation and increased risk of diversion into the interior Delta where survival is significantly reduced.

- A Sacramento River flow at Verona of less than 4,000 cfs is forecast* to occur within 21** days of the date when the hatchery salmon are ready to be released.
- A Sacramento River Flow of less than 6,000 cfs at Freeport is forecast to occur within 21** days of the date when the hatchery salmon are ready to be released.
- Delta Outflow is forecast* to be less than 3,000 cfs within 21** days of the date when the hatchery salmon are ready to be released.

If during any of these assessments, existing/predicted conditions are expected to meet the criteria triggering consideration of the alternative release strategy, then preparations will begin, continue, or be implemented to truck appropriate groups of fish to the acclimation net pens in San Pablo Bay as scheduled.

The remainder of the 5 million FRCS from the mitigation production will be marked at the standard constant fractional marking rate of 25% in groups of 1.0 million or 334,000 fish per tag code depending on raceway logistical needs. Batches of mitigation hatchery produced fish will be released when they reach target size of 60 fish/lb in April through June. Weight counts will be taken as fish are being loaded into transport trucks and recorded on release receipts following standard hatchery practices. Salt will be added to a level of ten parts per thousand to transport tanks prior to loading fish for transport. Transport equipment will not be allowed to make contact with receiving water to prevent the spread of aquatic invasive species.

The release location will be selected depending on weather, availability of net pens, and CDFW management review. Time of plant, temperature of receiving water and transport tank water, and the condition of the fish during release will be recorded on planting receipts. FRCS will be loaded into net pens at either Conoco Phillips then released into the San Pablo Bay. Mitigation production net pen releases will consist of 3 groups of 225K for a total of 1 million groups and 6 groups of 80K for a total of 334k in each group.

1.00 million Enhancement FRCS salmon will be marked at the standard constant fractional marking rate of 25% with a single tag code and loaded into net pens at Fort Baker then released near the Golden Gate Bridge. Enhancement fish will be released April-June at approximately 45 fish/lb. The Fort Baker release site will only be used if all access permit approvals can be obtained from the National Parks Service prior to

scheduled release. If permit approvals cannot be obtained in time to release fish at Fort Baker, the Enhancement fish will be released in the San Pablo Bay via Conoco Phillips or Mare Island net pens.

All net pen releases will be conducted on the outgoing tide and timed such that no more than two days of releases are scheduled in a row from the same location. Groups of 1.0 million like CWT fish may be split and released over two consecutive days from the same location as necessary to meet hatchery logistical constraints.

Date	Location	Fish/lb.	Total FRCS	With CWT and Mark
April-June	San Pablo Bay Net Pens	60	5.0 million	25%
June	Fort Baker	45	1.0 million	25%

Steelhead

Background:

The FRH conducts an artificial propagation program for CV steelhead trout on the lower Feather River. Natural origin CV steelhead are listed as a threatened species by the National Marine Fisheries Service. CV steelhead provide a popular freshwater sport fishery.

The FRH is operated by the California Department of Fish and Wildlife (CDFW) The primary purpose of the steelhead hatchery program is to mitigate for salmon and steelhead spawning and rearing habitat eliminated due to construction of Oroville Dam in 1968, and secondarily to support the ocean and freshwater fisheries. Annual mitigation goals for steelhead in the Feather River are to collect 1,000,000 eggs and release 450,000 yearlings (±10 percent) at 3 fish/pound.

6.0 Steelhead Broodstock Collection and Spawning Protocol

The HSRG provided several recommendations for the FRH generally and for Steelhead specifically. CDFW continues to incorporate those recommendations when possible. Non-anadromous (resident) fish should not be used as broodstock and the current 16-inch minimum length for broodstock should be continued. We acknowledge that resident *O mykiss* may occasionally exceed 16" in length. Broodstock for the program should only come from native, locally adapted stocks. The target is to use 10-50% natural origin broodstock. The HSRG recommends 10% natural origin broodstock as a minimum, even if it requires alternate collection locations and methods. Currently FRH is limited to broodstock collection at the hatchery itself and the incorporation of natural origin fish is between 1-10%.

Out-of-sub-basin importation of eggs, juveniles or adults should not occur, unless from Mokelumne River which has been shown to be genetically similar to the FRH broodstock, even if it means juvenile production targets will not be achieved in some years. It is not surprising that the Mokelumne River Fish Hatchery broodstock is genetically like FRH since the MRFH Steelhead were derived from FRH Steelhead several years ago. There are no specific goals for the number of adult steelhead produced by this program; however, the juvenile production goal is to release 450,000 yearling steelhead annually at three fish/pound during November.
All natural-origin steelhead are returned to the river (spawned or unspawned), all hatchery-origin females are returned to the river (spawned or eggs removed), and all hatchery-origin males are released back to Feather River at Verona. Prior to release 100 males will be acoustically tagged and released. 50 steelhead will be put in the Afterbay and 50 steelhead in the Feather River at Verona. This study will help managers track behavior and survival of hatchery origin males released back to the River.

A partial factorial mating scheme will be used for the fall 2018 Steelhead spawning program to help improve effective size, create more different genotypes in offspring, and hedge against infertile males and females. Coupled with genetic relatedness data on the parents, this design will enable FRH to determine if there is also a correlation of egg hatch rate and survival with levels of relatedness between the parents.

1) Spawning incorporates a 2x2 partial factorial mating scheme:

    a. Assuming two males and two females are available and ripe, the eggs from each female are divided into two separate pans. Each male is used to fertilize a separate pan. Thus, for two females (female A and B) and two males (male 1 and 2), a total of four pans are used, creating four individual families (A1, A2, B1, and B2).

    b. If there are an unequal number of males and females, FRH should perform a 2x3 or 3x2 partial factorial mating system.

    c. The 4 family groups (1A,1B,2A,2B) will be tracked separately by tray in the each stack:

		Males	
		A	B
Females	1	1A	1B
	2	2A	2B

    d. Individual males and females along with their gamete tray and stack information is identified on the envelopes containing the fin-clips for genetic samples. The individual egg trays are also be labeled with the parentage information linking back to the genetic sample. Eg. Females #1 and #2 and males #A and #B l each have a tissue sample collected from them, and the actual trays containing their eggs will be likewise labelled.

2) Genetic tissue samples (fin-clips) are collected such that genetic profiles can be associated with individual broodstock and the actual crosses performed:

a. Fin-clips are sent to the NOAA SWFSC genetics laboratory for genotyping each individual used for spawning.

3) Individual crosses are separated and tracked in egg trays as long as time and space permit (estimated 30-45 days post-fertilization). FRH is in the process of acquiring dividers for trays:

    a. FRH measures the approximate number of juveniles produced per family so that an accurate estimate of effective size can be calculated.

4) Consideration is given to culling egg lots from highly related parents after calculating relatedness for the parental crosses. Prior to any culling CDFW geneticist and the FRHOT will meet to discuss ramifications and make decisions regarding culling lots. Depending on the genetic results obtained from the SWFSC laboratory, the goal is to balance effective size with relatedness control. It has been documented that hatchery progeny created from crosses between broodstock at the half sib level of relatedness or greater do not survive or return to the hatchery.

5) Limit male re-use:
    a. The number of times each male fish is spawned is documented and tracked. The re-use of males is limited wherever possible, outside of the 2x2 or 2x3 spawning events.

6) Non-FRH fish should be not be spawned

    a. Candidate broodstock identified as Nimbus or Coleman-produced fish is not be spawned and will be euthanized.

6.1 Steelhead Release

All FRH steelhead are marked with an adipose fin-clip prior to release. For 2019, steelhead will all be released into the Feather River at the Boyd's Pump Boat Launch. In response to HSRG recommendations to release steelhead as far upstream as possible upstream (ie: Gridley boat launch) in-river release locations will be considered in future years.

IF the FRH survival is good and production is greater than 450,000 steelhead at 3 fish/pound, a release of not more than 10,000 steelhead will occur for the popular Afterbay Outlet fishery.

Attachment A: HSRG recommendations

California Hatchery Scientific Review Group (California HSRG 2012) has established recommendations for the FRH. For reference some of the recommendations that pertain to production are included:

5.6.1 Recommendations for All Feather River Hatchery Programs

- Clear goals should be established for the program. Program production goals should be expressed in terms of the number of age-3 ocean recruits just prior to harvest (Chinook salmon), and the number of adults returning to freshwater (steelhead).

- Transporting and releasing juveniles to areas outside of the Feather River and near or downstream of the confluence of the Yuba River should be discontinued. Juvenile fish should be released at the hatchery, or if not possible, as far upstream in the Feather River from the confluence of the Yuba River as possible to reduce adult straying and increase the number of adult fish returning to the hatchery. Consider necessary facility modifications or equipment purchases that will facilitate onsite releases. Release locations for steelhead may take into consideration ecological and predation effects on other fish populations but should not compromise homing of adults to the hatchery.

- Managers should investigate the feasibility of collecting natural-origin adult fish at alternate locations. The existing trapping location is very limited in its ability to capture fish representing the entire spectrum of life history diversity. Only fish that migrate to the furthest upstream reaches are susceptible to capture.

- Adult holding facilities should be upgraded and/or expanded to provide adequate space, water flows and temperature regimes to hold the number of adults required for broodstock at high rates of survival (greater than 90 percent). In addition, because of a lack of adult holding space, fall Chinook are returned to the river to make room for late arriving spring Chinook. Evaluate the prospects of using the Thermalito Annex Facility for the long-term holding of spring Chinook broodstock. While the Annex water temperature is relatively high, a pilot study could be used to determine whether any associated increased holding mortality was sufficiently offset by the Annex's otherwise excellent water quality.
- Natural-origin fish should be incorporated into broodstock at a minimum rate of 10 percent to prevent divergence of the hatchery and natural components of the integrated population. This may require auxiliary adult collection facilities or alternative collection methods (e.g., seining or trapping).

- A Monitoring and Evaluation Program should be developed and implemented and a Hatchery Coordination Team formed for the program. Implementation of these processes will inform hatchery decisions and document compliance with best management practices defined in this report.

- Performance standards for each phase of the fish culture process should be established and tracked annually. Summaries of data collected with comparisons to established targets must be included in annual hatchery reports.

- CDFG should develop and promulgate a formal, written fish health policy for operation of its anadromous hatcheries through the Fish and Game Commission policy review process. Hatchery compliance with this policy should be documented annually as part of a Fish Health Management Plan. The current CDFG fish health policy is inadequate to protect native stocks.

- CDFG should develop an updated Hatchery Procedure Manual which includes performance criteria and culture techniques presented in IHOT (1995), Fish Hatchery Management (Wedemeyer 2001) or comparable publications. The fish culture manual (Leitritz and Lewis 1976) is outdated and does not reflect current research and advancements in fish culture.

5.6.2 Feather River Fall Chinook- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather River fall Chinook salmon hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation objectives or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- Use of the Feather River Annex for rearing should be discontinued unless juveniles are released near the Annex and an adult collection facility is installed in the downstream outlet of the Thermalito Afterbay.

- The program should limit the number of eggs taken to the number necessary to meet production goals (which would include a reasonable overage to account for egg loss and culling of spring x fall crosses). On average, the program takes about 20 million eggs to produce 6 million juveniles.

- Tag analysis should be used to determine the fall and spring hatchery-origin Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).
- Only unmarked fish should be spawned in the fall brood (FRH spring Chinook are 100 percent adipose fin-clipped, FRH fall Chinook are 25 percent adipose fin-clipped) to reduce the need for culling. Any spring x fall Chinook crosses of hatchery-origin fish (e.g., due to marking or mark detection errors) should be identified by coded wire-tag analysis and eggs should be culled soon after spawning.

- Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such

fish, they should be culled soon after spawning.

- Program fish should be 100 percent coded wire-tagged and 25 percent adipose fin-clipped.

5.6.3 Feather River Spring Chinook- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather spring Chinook salmon hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation goals, or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- Tag analysis should be used to determine the number of fall and spring Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).

- Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

5.6.4 Feather River Steelhead- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather River steelhead hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation goals or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- A Hatchery Coordination Team should be established to review the status of the FRH steelhead program.

- The number of eggs taken annually should be reduced to a level appropriate to produce 450,000 juveniles and the transfer of eggs to other programs terminated. Collection of excess eggs is permissible to increase effective population size as long as culling is done representatively.
- Broodstock for the program should only come from native, locally adapted stocks. Out-of-subbasin importation of eggs, juveniles or adults should not occur, even if it means juvenile production targets will not be achieved in some years.

- Non-anadromous (resident) fish should not be used as broodstock and the current 16-inch minimum length for broodstock should be continued.

- Hatchery-origin adult steelhead returns to the hatchery should be treated as follows: (1) unspawned males should be extended reconditioned and released; (2) unspawned females should be stripped of eggs, extended reconditioned and released; and (3) spawned fish should be removed from the system, or extended reconditioned and released.

- Natural-origin adult steelhead returns to the hatchery, whether spawned or unspawned, should be released. Fish may be reconditioned prior to release.

    - The program should limit the number of eggs taken to the number necessary to meet production goals (which would include a reasonable overage to account for egg loss and culling of spring x fall crosses). On average, the program takes about 20 million eggs to produce 6 million juveniles.

    - Tag analysis should be used to determine the fall and spring hatchery-origin Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray). Only unmarked fish should be spawned in the fall brood (FRH spring Chinook are 100 percent adipose fin-clipped, FRH fall Chinook are 25 percent adipose fin-clipped) to reduce the need for culling. Any spring x fall Chinook crosses of hatchery-origin fish (e.g., due to marking or mark detection errors) should be identified by coded wire-tag analysis and eggs should be culled soon after spawning.

    - Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

Attachment B: Draft Conservation Facility Subgroup 2018 Donor Stock Recommendation

for the

Reintroduction of Central Valley
Spring-Run Chinook Salmon into the San Joaquin River

December, 2017

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CONSERVATION FACILITY SUBGROUP 2018
Draft Donor Stock Recommendation

Executive Summary

This document recommends collection of 2018 BY spring-run Chinook salmon donor stock for the San Joaquin River Restoration Program and recommends updates to the Program's 2017 Donor Stock Collection Plan. In 2018/19, the Conservation Facility Subgroup recommends the collection of up to 5,470 individuals from either Feather River Fish Hatchery (FRH), the San Joaquin River (SJR) or Butte Creek with the collection from Butte not to exceed 2,910 juveniles and from SJR not to exceed 2,980.

Egg collections from FRH would occur during the 2018 spring-run spawning period during September and October and juvenile collections would occur from Butte Creek between December 2018 and March of 2019. Egg or juvenile collections would occur on the SJR between October 2018 and March 2019. The fish will be used as captive broodstock at the Program's interim Salmon Conservation and Research Facility (Interim Facility). The ability of the Interim Facility to rear the individuals through adulthood is dependent on completing construction of the full-scale Salmon Conservation and Research Facility (SCARF) by June 2018. Eggs from Feather River Fish Hatchery would be selected from among 350 crosses segregated for the Program. Eyed eggs would be transported to quarantine for hatching and pathogen screening. Juveniles would then be transferred to the Interim Facility where they would be coded wire tagged and reared through adulthood and spawned. Butte Creek juveniles would be collected from a rotary screw trap and a diversion trap, transported to quarantine for fish health screening, and transferred to the Interim Facility for rearing. SJR eggs would be collected by redd extraction at the eyed stage and transported to quarantine for fish health screening, and SJR juveniles would be collected through emergence traps or a rotary screw trap, transported to quarantine for fish health screening, and transferred to SCARF for rearing. The growth rate juvenile broodstock males would be modulated to help prevent early maturation.

1. Introduction

The San Joaquin River Restoration Program (Program) is responsible for executing the legal settlement from the lawsuit, Natural Resources Defense Council et al. v. Kirk Rodgers et al. (NRDC v. Rodgers 2006). As a part of this settlement, the Program is required to reintroduce spring-run Chinook Salmon to the San Joaquin River. A conservation broodstock program was initiated at the Interim Facility in Friant, CA to help implement settlement actions. Due to the threatened status of the species, the Program has developed the Donor Stock Collection Plan (DSCP), a process to guide fish collections and to inform the National Marine Fisheries Service (NMFS) of these collections pursuant to the 10(a)(1)(A) Enhancement of the Species Permit for broodstock (Permit 14868, 77 FR 67796) and the Hatchery & Genetic Management Plan (SJRRP 2016). A DSCP will be developed annually by the Program's Donor Stock Collection Work Group with input from the Conservation Facility Subgroup (CFSG). The CFSG is responsible for recommending fish collections from the donor population for rearing at the Program's Conservation Facility and for preparing protocols for fish collections and fish rearing at the facility. The subgroup includes representatives from State and Federal fishery jurisdictional agencies such as the California Department of Fish and Wildlife (CDFW), United States Fish and Wildlife Service (USFWS), NMFS, fisheries biologists from the Bureau of Reclamation (USBR), and geneticists from the NMFS Southwest Science Center (Santa Cruz, CA).

The low escapement in 2017 of spring-run Chinook salmon to FRH and Butte Creek prevented collection of broodstock for the Program this past year. Therefore, this document recommends

modifications to the 2017 DSCP Annual Report, in addition to recommendations for the 2018 egg collections from the Feather River Hatchery (FRH) in September and October, and juvenile collections from Butte Creek in December through March of 2019.

2. Broodstock Collection History

Spring-run Chinook Salmon broodstock have been collected annually for the Program from the FRH since 2012, with the exception of no collections occurring in 2017. The decision to include the Feather River population as a source for donor stock is discussed in the Program's Stock Selection Strategy (SJRRP 2010) and the Program's 10(a)(1)(A) Permit 14868. In most years, the FRH has met its production goal of two million spring-run Chinook Salmon smolts. To reach this target, the hatchery spawns approximately 750 adult pairs to collect approximately three million eggs. Spring-run Chinook salmon at the FRH are identified by run timing. Adults that enter the hatchery in the spring (May – June) are marked with two dart tipped Hallprint® tags and returned to the river to hold over summer (Cavallo et al. 2012). Only Hallprint tagged fish are categorized as spring-run when adults return to the hatchery in the fall. The hatchery's fish ladder is open from around September 15th through the following June to ensure that spring- and fall-run Chinook Salmon and steelhead have an opportunity to enter the hatchery. During the first few days of hatchery spawning, salmon that enter the hatchery are sorted into separate holding tanks based on the presence or absence of a Hallprint tag. Spring-run adults are then spawned in the coming days until the egg-take production goal is met. The spring-run Chinook spawn typically lasts from one to three weeks.

In 2017, because of the low spring-run Chinook salmon escapement numbers in the Central Valley, the SJRRP did not collect a 2017 brood year from either Feather River or Butte Creek. The low returns are likely a delayed response to California's previous extended drought period. The number of eggs previously collected for broodstock from the FRH for the Program are listed in Table 1. Initially the program collected 560 eggs for broodstock from the FRH to meet the fish production goal of spawning 50-100 adult pairs each year at the Interim Facility. In 2015, the collection was increased to 1,935 eggs in anticipation of spawning up to 300 females in September 2018. However, delays in the construction schedule for the Salmon Conservation and Research Facility (SCARF) have resulted in the need to reduce a portion of the fish collected in 2015 and the collection of fewer eggs in 2016. In 2017, the Conservation Facility Subgroup recommendation was to collect up to the total permitted amount of 2,760 eyed eggs from FRH, and/or juveniles from Butte Creek but due to low escapement on both systems, no collections occurred.

Table 1. Number of eyed eggs collected annually from Feather River Hatchery for broodstock development.

Collection Year	Number of Adult Pairs Mated	Number of Eyed Eggs Collected
2012	90	560
2013	90	560
2014	105	560
2015	360	1,935
2016	350	704
2017	0	0

3. Recommended 2017 Donor Stock Collection Plan Modifications

In effort to mitigate the absence of 2017 BY broodstock, the CFSG recommends utilizing one or more of three existing groups of fish that are currently being held at the Interim Facility and the

Salmon Incubation and Rearing Facility (SIRF) at Friant Dam. These include: (1) Translocation Yearlings that are siblings of the 2016 BY (2) Interim Facility Production Yearlings and (3) Interim Facility production young-of-year.

Translocation Yearlings - The translocation yearlings represent first generation hatchery fish that would be used to boost the population and genetic variability of the 2016 broodstock. The fish were acquired as eggs with the 2016 BY broodstock from FRH. At that time, 80,000 eggs were collected for translocation. The eggs were collected from 350 spring-run Chinook adult pairs. The eggs were transferred to the SIRF for incubation and rearing. After hatching, the fry were reared to a suitable size for coded-wire tagging. The majority of fish were released to the San Joaquin River in March 2017, but approximately 1,400 fish remained at the SIRF to be released as yearlings. In August of 2017, the yearlings were PIT tagged and tissue sampled for genetic analysis. The pedigree of these fish will be compared to the pedigree of the existing 2016 BY broodstock and family lines not sufficiently represented in the current broodstock may be selected in effort to maximize the genetic variability.

Interim Facility Production Yearlings – The Production Yearlings were produced at the Interim Facility in 2016 and are second generation hatchery fish, but likely possess genetic variability that is not represented in the 2016 BY broodstock. The fish were produced at the Interim Facility in September 2016 from a total of 72 females and 98 males. The majority of fish were released to the San Joaquin River in March 2017, but approximately 1,400 fish were transferred to the SIRF to be released as yearlings. In August of 2017, the yearlings were PIT tagged and tissue sampled for genetic analysis. Again, the pedigree of these fish will be compared to the pedigree of the existing 2016 BY broodstock and family lines not sufficiently represented in the current broodstock will be selected in effort to maximize the genetic variability.

Interim Facility Production Young-of-Year – The 2017 production fish were produced at the Interim Facility and are also second generation hatchery fish, but may be a suitable alternative in lieu of the absence of the 2017 BY broodstock. The fish were produced at the Interim Facility in September/October of 2017 from a total of 104 females and 167 males. The eggs from most females were subdivided and, depending on the number of eggs, were fertilized with 1 to 4 males totaling 326 individual crosses. While the crosses are segregated in individual egg dividers, a total of up to 2,760 will be selected for broodstock. The majority of the remaining fish will be released to the San Joaquin River in March 2018, but approximately 10,000 fish will be retained and released as yearlings in the fall of 2018.

The final decision for the Program to use one or more of the proposed groups of fish described above will be based on the recommendations of the Program's CFSG, the Genetic Subgroup, the Fishery Management Workgroup, and the Department's Fish Health Lab. In addition, the ability to rear these individuals through adulthood will be dependent on space availability at the Interim Facility, and whether there are delays in completion of new SCARF. If it is determined that the Interim Facility would not be able to accommodate the full collection of BY 2017, the Program would pursue releasing excess broodstock to the SJR in accordance with existing permits. A final decision regarding the number of broodstock collected should be made by December 1, 2017.

3.1. 2018 Feather River Fish Hatchery Collection Method

A sufficient number of eggs must be collected to satisfy broodstock needs and to meet other Program objectives, including future yearling and adult releases to the San Joaquin River as allowed by Section 10(a)(1)(A) Permit 17781 (79 FR 26944). In 2018, it is recommended that up to 5,470 eggs be collected for broodstock, reared to adults and eventually spawned starting in the fall of 2020 (grisles), with the bulk spawned in fall of 2021. Fewer eggs will be collected if it is

determined that juveniles will also be collected from Butte Creek. In all, the total collection will not exceed 5,470 individuals. The resulting offspring would be released to the San Joaquin River in accordance with active NMFS permits. The collection would include 70 eggs to account for the 70 juveniles that are to be sacrificed for pathology and a sufficient number of males in effort to produce a 2:1 male female spawning ratio. Program staff would segregate eggs from a minimum of 350 paired matings, which would allow rejection of a significant number of crosses and yet provide substantial genetic variability in the future broodstock population. Individual fish data would be tracked for each cross including: Hallprint® tag number, Hallprint® tagging date, adipose fin status, head tag number, coded wire tag (CWT) number, sex, fork length, ovarian fluid pathogen analysis, volume of flaccid eggs per female, daily egg expansion factor, female fecundity, tissue sample number and corresponding genetic analysis data. The data would then be used to select eyed eggs from preferred crosses based on Program criteria. Eggs would be collected at the FRH on at least three individual spawning dates from a total of 350 crosses to capture a high degree of genetic variability, based on the recommendations of the Program's Genetic Subgroup. Parents selected for these crosses would be comprised of 5 percent or less of two-year-old adults in accordance with NMFS Permit 17781. Fish with adipose fins (i.e. supposed wild origin spring-run) may be used in crosses in effort to reduce hatchery induced selection. During spawning, ovarian fluid would be collected from each female, pooled in groups of four or five samples and screened for viruses and bacteria, including infectious hematopoietic necrosis virus (IHNV) and *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD). Fertilized eggs from two crosses would be placed into an individual vertical tray egg incubator, disinfected with iodophore and incubated at the FRH according to the FRH HGMP (Cavallo et al. 2012). During incubation, data would be compiled to determine which crosses meet the following selection criteria:

- Disease status - The parental ovarian fluid tests negative for IHNV and BKD
- Run-timing
  - Both parents are Hallprint® tagged
  - CWTs (if present) verify the spring-run phenotype
- Age of maturity – Two-year-old males and females would comprise 5% or less of the parental crosses unless necessary to meet Program goals

Once preferred crosses have been identified, eyed eggs would be selected by hand counting near equal number of eggs from each cross until a maximum of 5,470 are obtained from the segregated crosses and transported to the Silverado Fisheries Base in Yountville (or to another recognized quarantine facility) for quarantine and temporary holding. Crosses would not be selected unless the FRH spring-run egg collection goal has been met and approximately 350 pairs are spawned for potential use. If fish are collected from Butte Creek, the FRH collection would be reduced to keep the combined fish collection below 5,470.

3.3. Butte Creek Collection Method

The Program currently proposes to collect up to 2,910 juveniles from Butte Creek between December 2018 and March 2019 (2,700 for broodstock, and 210 for pathology). As per Section 10(a)(1)(A) Permit Application 20571 (in process), collection will be dependent on annual spawner escapement to Butte Creek, and proportion of collections from other donor sources, and may range up to 2,910 individuals per year. No juveniles will be collected if the number of female spawners is less than 250. The maximum number collected will scale up from 250 on a two to one basis with the number of female spawners up to 1,455. When the number of female spawners exceeds 1,455 up to the maximum of 2,910 juveniles may be collected. Escapement on Butte Creek will be determined by either direct adult counts at a counting weir or by snorkel

survey estimates during the holding period. Escapement estimates by carcass surveys would be used for validation and to account for pre-spawn mortality. These surveys are conducted annually by CDFW regional staff, who would be consulted in August or September each year to discuss annual escapement and juvenile collection numbers for each brood year. Validation of escapement and confirmation of collection numbers would occur after carcass surveys are complete. Environmental conditions affecting the Butte Creek population (e.g., drought, fire) would also be considered in determining annual collection numbers. The Program will collect juveniles from existing sampling occurring on Butte Creek. Collections would use the seasonal Rotary Screw Trap (RST) and side diversion trap at the Parrot-Phelan Diversion Dam near Chico, which are used for monitoring spring-run juvenile out-migrants. The site is directly downstream of spring-run spawning habitat and upstream of fall-run Chinook salmon spawning habitat, although periodically fall-run spawn above the site. Genetic diversity is increased by collecting juveniles after they have mixed with other unrelated individuals within the source stream. At these sites, the proposed maximum broodstock collection numbers would represent just 0.1 to 5.3 percent of captured juveniles, based on trap records for the 2012-2013, 2013-2014, and 2014-2015 seasons (Garman 2013, 2014, and 2015). As typical efficiency rates for RSTs are very low, collections would represent a much smaller proportion of the total number of juveniles in the system (i.e., fraction of 1%).

The collection of juveniles on Butte Creek would occur 1-3 times per week throughout the outmigration period in order to maximize the genetic diversity of individuals collected for broodstock. Collections would begin in December of each year and would extend through March, which is expected to encompass at least 95 percent of the juvenile outmigration period. During fish processing activities at the RSTs, a subsample of randomly selected juveniles of different size groups would be selected for broodstock collection. Life stages collected (e.g., fry, parr, smolt), fork length ranges for each size group, and numbers collected of each per collection event would vary throughout the collection period in order to track those seen in the natural population. If, after initial collections, it becomes evident that size selection would be useful to eliminate fall-run Chinook salmon individuals from the sample, then that may be used. Collected juveniles would be transported (using protocol SCF-TRN-001-03) to the holding site where they would be held in tanks or cages (which may include cages that are attached to the screw traps; protocol in development) until transferred to the SFB for a minimum 30-day holding and fish health assessment. Thereafter, the individuals would be transferred to the Interim Facility or SCARF for rearing to adulthood. At some point prior to spawning, the broodstock would be analyzed genetically, and any fish identified as fall-run would be removed from the broodstock population. The final disposition of the fall-run would be determined within the Fisheries Management Workgroup in consultation with NMFS. Annual collections from Butte Creek would be segregated into up to three groups for quarantine and fish health assessment in order to reduce the potential for disease transfer between early and late collections of fish.

3.4 San Joaquin River Egg and Juvenile Collection Methods

In the event that adult spring-run Chinook salmon return to the SJR in the spring of 2018, efforts will be made to collect up to 2910 offspring for broodstock as either eggs or juveniles. The Program does not intend to capture adults for collecting egg this year since this method would likely require the holding of adults, which will not be possible until the SCARF is complete. Some captive broodstock programs favor redd extraction for broodstock collection to target collecting small numbers of eggs from specific redds to better control of genetic variability and reduce the risk of disease transfer. The SJRRP will pursue two basic methods for redd extractions; either redd pumping or redd excavation. Up to 20 eggs per redd may be collected to

be incorporated into broodstock to limit the number of siblings in the broodstock. Broodstock collected as eggs will be transferred or held for quarantine and fish health assessment prior to being transported to the SCARF.

Eggs will be collected approximately 20-30 days post-spawning from redds, depending on water temperatures. Eggs are most resistant to disturbance after 200 accumulated temperature units (ATU's in degrees C). Eggs will be collected prior to 480 ATU's, which is when hatching can begin for Chinook salmon eggs (Börk et al., 2016). Depending on the specific on-site conditions, either redd pumping or redd excavation may be used as the preferred extraction method, as described below. On-site decisions will be based on water clarity, water velocity, water depth, risk to non-target eggs and safety considerations of field staff. With either technique, eggs will be removed from each redd until the desired number reached (< 20 viable eggs per redd). This equates to approximately < 0.2 percent of the eggs from an individual female. Therefore, a take of 0.4 percent of the eggs from a female at this lifestage should be sustainable as long as survival of the non-taken eggs can be maintained. Egg to fry survival rates in the Interim Facility and SCARF is anticipated to exceed 50 percent, with a target of 70 percent or greater. Egg to fry survival in naturally spawned Chinook salmon eggs is extremely variable, and depends on a number of factors, including temperature, flow, gravel composition, percolation rate, etc. Total eggs collected will depend on redd availability.

3.4.1 Redd Pumping (Börk et al., 2016)

If redd pumping is conducted, eggs will be collected from redds using a small portable backpack mounted water pump as described by Murdoch and Hopely (2005). An aluminum probe is inserted into the redd. The probe is designed with an air intake, which creates a Venturi effect that combines water and air. The mixture of air and water is used to float eggs to the surface. A collection basket covered with wire mesh and a cloth net bag on the downstream side will be used to collect eggs. The basket will be placed over the portion of redd to be sampled. In an effort to minimize stress to the redd, hydraulic sampling will begin at the farthest most downstream point of the tail spill and progressed systematically upstream as necessary. This method ensures that disturbance to the redd is confined to the furthest downstream portion of the redd, decreasing the probability of impacts from personnel (i.e., stepping on egg pockets) or the sampling process (e.g. changing the hydraulics of the redd). Each redd will be sampled carefully until the first egg is collected and the developmental stage verified (i.e. eyed-egg stage). Eyed-eggs will be removed from the collection net by hand or with a small dip net and placed in small buckets. Buckets will then be placed in coolers on ice for transport to quarantine. Excess eggs will be re-injected into the redd using the hydraulic egg planter or carefully returned to the redd by hand.

3.4.2 Redd Excavations (as described in Börk et al., 2016)

Redd excavation consists of carefully hand-digging into the tailspill of identified spring-run redds to obtain live fertilized eggs. The specific redds from which eggs are to be obtained, will be selected from areas of shallower water and gentle velocities to facilitate obtaining eggs without loss. Gravel will be carefully removed from the tailspill of the red, by hand until eggs are reached. The digging process will proceed slowly so that a clear view of the excavated area can be maintained throughout the process. Snorkel gear will be used to get a clear underwater view of the excavated area. A fine mesh dip net will be used to retrieve the eggs. Eggs will be placed into a bucket of river water, maintained at or below the temperature of the river, as they are removed from the gravel. They will be counted as they are placed into the bucket until the desired number of eggs is reached (< 20 eggs). Once the eggs are obtained from the redd, gravel will be carefully replaced into the area from which it was removed until the pre-disturbance substrate contour is recreated.

3.4.3 Emergence traps (as described in the SJRRP 2017 10a1A Application)

Fry emergence monitoring will be conducted in conjunction with the carcass and red monitoring using emergence traps (Koski 1966; Hausle and Coble 1976; Beacham and Murray 1985; TID and MID 1991). A stratified random sampling design based on time periods and survey reaches will be used to select redds for emergence monitoring. Water temperature data for each redd will be obtained from the nearest CDEC gaging station to estimate emergence timing via accumulated thermal units prior to installing emergence traps (ATUs; Beachum and Murray 1990). ATUs will be calculated by adding average daily temperatures, 1 ATU = 1 °C for 1 day (Beacham and Murray 1990) and assume that emergence will start at approximately 700 ATUs. Emergence traps will be installed on selected redds no more than two weeks (i.e., 3 to 14 days) prior to the start of expected emergence to minimize the potential for the traps to influence the hydro-geomorphology within monitored redds.

Emergence traps consist of 0.32-cm nylon mesh covering a steel frame and a 30.48-cm canvas skirt made of Dacron sailcloth buried vertically into the gravel to minimize lateral escapement of fish. Emergence traps are tear-shaped and contain a live-box at the narrower caudal end of each trap, which is oriented downstream. Emergence traps measure 2.42-m long and 1.83-m at the widest point, and had an area of approximately 2.83 m2. The live-box is assembled to collect emerging fry using a 3.79-L wide-mouth polyethylene bottle attached at the bottom to a 15-cm diameter funnel. Holes are cut into both sides of the live-box and 0.32-cm polypropylene mesh is attached with silicone to create a vent, allowing water to escape and minimizing fish mortality. A sock constructed of Dacron sailcloth extended from the downstream end of the trap to the live-box is attached using a hemmed drawstring around the lip of the funnel.

During installation, each emergence trap is placed on top of the distinct egg pocket. Subsequently, rebar measuring 0.95-cm thick by 76.20-cm long is installed around the emergence trap frame and secured to the frame using washers and hose clamps. The rebar is installed approximately 50-cm into the riverbed using a manual post pounder. Thereafter, a trench will be excavated around the edges of the trap at a depth of 30.48-cm or until the substrate becomes too armored for digging to continue. Finally, a canvas skirt is buried within the trench, the excavated area is backfilled, and the live-box is attached to the narrow caudal end of the Emergence traps

3.4.4 Rotary Screw Trap Collection

Juveniles may be collected by RST on the SJR which will be checked at least once daily to process fish and remove debris. Under high debris loads, the trap will be checked and cleaned more frequently. If conditions in the livebox suggest that in-trap predation is a concern, fish refuge devices will be installed within the livebox to dissipate water velocities and reduce predation. If fish refuge devices seem to be causing mortality or injury to listed fish these features would be modified or removed to reduce their adverse effects. When monitored at the appropriate time interval relative to the number of fish being collected, RSTs result in low mortality rates. Juvenile spring-run Chinook salmon outmigration is be monitored annually by RST on the SJR. In some cases, capture locations may allow the capture of both fall- and spring-run Chinook salmon. If, after initial collections, it becomes evident that size selection would be useful to eliminate fall-run Chinook salmon individuals from the sample, then that may be used. In these scenarios, larger yearling spring-run Chinook salmon may be targeted, as they are most readily distinguished from fall-run Chinook salmon. Collected fish will be genetically tested and PIT tagged to verify spring-run Chinook salmon origin sometime after they reach a minimum fork length of 65 millimeters and may not occur until after juveniles are transferred to SCARF or the Interim Facility.

3.5 Quarantine and Fish Health Testing

While in quarantine, the SFB would rear eggs and juveniles under the direction of Program staff. Eggs collected at the FRH will be hatched and held at the SFB for a 30 day quarantine period until being transferred to the Interim Facility or SCARF. Juveniles collected from Butte Creek fish would be held in up to three individual lots/tanks until pathology testing is complete. Approximately 30 days prior to transportation, a maximum of 70 juveniles per lot would be sacrificed for fish health assessment by CDFW's Fish Health Laboratory in Rancho Cordova. In the spring of 2019, the remaining fish would be transferred to the Interim Facility or SCARF. Oxygen levels would be maintained at or above saturation during transport and temperature would be tempered to within 2 °F of the receiving water, pursuant to an accepted fish transfer protocol. If SFB is unavailable for holding fish, an alternate quarantine facility will be selected in cooperation with the CDFW Fish Health Lab.

3.4. Husbandry

At the Interim Facility or SCARF, dissolved oxygen, temperature, mortality, and feed quantity would be measured daily. Fish weights and lengths would be measured every 1-4 months as needed. Fish will be anaesthetized prior to being measured to reduce stress from handling. Fish would be fed standard salmon feed and a strict feed regimen would be instituted using the GROW program to modulate growth rates. Females will be offered a near full ration [75-160% for Chinook Salmon Allowable Growth Rate (AGR)]. Males will be offered a partial ration (i.e. 25-50% of AGR) during September through March of each year to limit maturation (Larsen et al. 2012).

3.5. Marking and Tagging

Once transferred to the Interim Facility or SCARF, fish will be marked using a CWT and adipose fin-clip. After fish reach a fork length of approximately 65 mm, we will collect tissue samples for genotyping and sex identification, and mark with a Passive Integrated Transponder (PIT) tag. The PIT tag number and corresponding fish data would be stored on a Microsoft Access or Excel database.

3.6. Tissue Sampling

Tissue samples would be taken after fish have been PIT tagged according to the Interim Facility protocol SCF-GEN-001-03. All tissue samples would be assigned the corresponding PIT number. Tissues will be transferred to the CDFW Tissue Archive located in Sacramento, CA for processing.

3.7. Sex Identification

Sex identification through tissue analysis will be completed on the 2016 BY broodstock the by NMFS' Southwest Science Center located in Santa Cruz, CA. Results from these analyses would be used to segregate fish according to sex between July and September of 2017 in an effort to reduce the precocity rate of males through growth rate modulation. Fish exhibiting precocious maturation would be enumerated by identifying primary or secondary sexual characteristics or through use of ultrasound.

3.8. Final Disposition

3.8.1. BY 2012 to 2016 Broodstock and Resulting Offspring

Mature BY 2012 through 2016 broodstock will be spawned in September/October 2018 using a mating matrix provided by the NMFS Southwest Science Center to maximize genetic diversity in the resulting offspring. The target for the ratio for males and females used in spawning would be between 2 to 1 males per female to increase the effective population size of the offspring and improve the chance that returning adults would be less related. Grisles (mature age-2 males)

from the BY 2016 may be spawned with up to 20% of the BY 2012-2015 females although this percentage may be higher if there are not a sufficient number of older males for spawning. Eggs from each female would be split up to four ways and each quarter would be spawned by a different male using a factorial mating design. Each quarter would be incubated separately in a divided egg incubator tray. Survival to the eyed and emergence stage will be enumerated. Family lines would be mixed shortly after emergence. The offspring will be 100% coded wire tagged and adipose fin-clipped in early 2019 prior to release to the SJR. An estimated 200,000 - 250,000 juveniles would be released to the San Joaquin River. Some adults may be released to the river around June 2018 and up to 10,000 yearlings would be released in November, 2019.

3.8.2. BY 2016

The BY 2016 broodstock would continue to be reared at the Interim Facility. Grisles may be spawned with up to 20% of the BY 2012/13/14/15 females in September/October 2018. Ancillary BY 2016 broodstock may be released to the river in 2018 or 2019 in accordance with current permits. NMFS will be sent a notification prior to any fish releases. Up to 100 broodstock may be retained specifically for release to the San Joaquin River Restoration Area in the summer of 2019, as mature adults in accordance with Permit 17781.

3.8.3. BY 2017 Broodstock

The BY 2017 broodstock (source still undetermined) would be reared at the Interim Facility once received from the SIRF. Ancillary BY 2017 broodstock may be released to the San Joaquin River Restoration Area as yearlings in the fall/winter of 2018/2019, as dictated by the holding capacity at the facility in accordance with current permits.

3.8.4. BY 2017 Interim Facility Juveniles

Juveniles that were spawned at the Interim Facility in the fall of 2017 will be coded wire tagged in January through March of 2018 and released to the San Joaquin River in February or March of 2018. Up to 10,000 may be retained for yearling releases and up to 2,760 fish may be retained as broodstock.

4. 2018 Interim Facility Actions Timeline

- January/February/March 2018
    - Sacrifice 70 of the BY 2017 juvenile broodstock for fish health assessment
    - CWT and adipose fin-clip BY 2017 juvenile broodstock
    - CWT and adipose fin-clip BY 2017 SCARF juveniles
    - Release BY 2017 Interim Facility juveniles to the SJR

- March-May 2018
    - Upon approval from the Fish Health Lab, transfer BY 2017 juveniles to the Interim Facility
    - Once exceeding 65 mm in fork length, tissue sample and PIT tag BY 2017 juveniles at Interim Facility
    - Send BY 2017 tissues to NMFS Science Center via Tissue Archive for analysis

- June 2018
    - Ultrasound BY 2012 - 2015 adults and release up to500 to the SJR

- July 2018

- Receive sex identification results for BY 2017 broodstock from NMFS Science Center
- Monitor incoming water temperatures and utilize water recirculation and chilling equipment if needed
- After completion of SCARF construction, transfer the Interim Facility inventory to SCARF

- August 2018
  - Sort BY 2017 juveniles according to sex and begin growth modulation
  - Identify number of mature males and females from BY 2012-16 using ultrasound
  - Receive mating matrix for BY 2012-16 adults and grisles from Southwest Science Center

- September 2018
  - Begin spawning of adults at the new SCARF
  - Collect test ovarian fluid and kidney tissue from spawned BY 2012-15 adults and Grisles at SCARF for analysis (Coordinate with Fish Health Lab)
  - Fish ladder opens at FRH around September 15. Spawn BY 2018 at FRH and collect samples for fish health assessment

- October 2018
  - Continue spawning remaining BY 2012 - 16 adult broodstock at SCARF
  - Receive pathology data from ovarian fluid at SCARF and discard BKD and IHNV positive eggs
  - Receive pathology and CWT data for screening BY 2018 broodstock eggs at FRH
  - Transfer up to 5,470 BY 2018 broodstock eggs from FRH to quarantine

- November/December 2018
  - Incubate eggs and fry in quarantine and Interim Facility

- December 2018 through March 2019
  - Spring-run juvenile collection on Butte Creek
  - Transfer of up to three groups of juveniles to quarantine

- March through May 2019
  - Transfer of Butte Creek juveniles to Interim Facility or SCARF for tagging (CWT and PIT), tissue sample and rearing

5. Recommended Research

The CFSG recommends that the following research be considered for implementation in 2017. All research projects would be reviewed and approved by the FMWG and NMFS prior to initiation. The Conservation Subgroup recommends that the following research be considered for implementation in 2018:

1. Practice egg extractions from redds in the SJR that were constructed from hatchery adults released to the river from the Interim Facility/SCARF.
2. Investigate methods to produce larger females for spawning to improve egg and juvenile quality;

3. Implement plan for releasing of Interim Facility produced adults to river in the Summer/spring/fall of 2018. Determine best method for tagging fish;
4. Investigate conservation hatchery strategies to reduce hatchery induced selection; and,
5. Develop projects for new SCARF research room.

6. References

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