Proposed Action

The proposed modifications to the Plan include adding the following under Section VII Proposed Delta Operations – June Through November 15:

San Joaquin River Flows at Vernalis and Water Transfer Window

- D-1641 San Joaquin River flows at Vernalis
    - Reduce the month-long average fall attraction base flows from 1,000 cfs to 800 cfs for 31 days
    - Action to occur between October 1 and November 15, 2014 (release schedule starting date to be based on fish agency recommendations)

- Water transfer window
    - Extend the transfer window through November 15, 2014, to allow the conveyance of approximately 75 to 90 TAF of transfer water (excluding carriage water) that has been retained in Shasta and Folsom reservoirs for diversion from the south Delta at the Jones Pumping Plant
    - Include alerts and triggers related to the presence of listed threatened or endangered fish species that will reduce or suspend conveyance of transfer water while fish movement is assessed (based on fish agency recommendations using monitoring alert and triggers in NMFS BiOp Action IV.1.1)

Conceptual Model, Life History, and Status of Species

Salmonids

Four Chinook salmon runs, which are differentiated by the timing of the adult spawning migration (fall-run, late-fall-run, winter-run, and spring-run) are found in the Central Valley. NMFS (64 FR 50394) determined the four Central Valley Chinook salmon races comprise three distinct Evolutionarily Significant Units (ESUs): the fall/late fall-run, the spring-run, and the winter-run. The Sacramento River winter-run Chinook salmon ESU is restricted to a single population. The Central Valley spring-run Chinook salmon ESU is comprised of multiple self-sustaining wild populations (Mill, Deer and Butte Creek), although additional spring-run Chinook salmon populations exist in the mainstem Sacramento River, Feather River and Clear Creek. All these species share similar life stages, biological responses to habitat attributes, and exposure to environmental and management drivers (Figure 1).

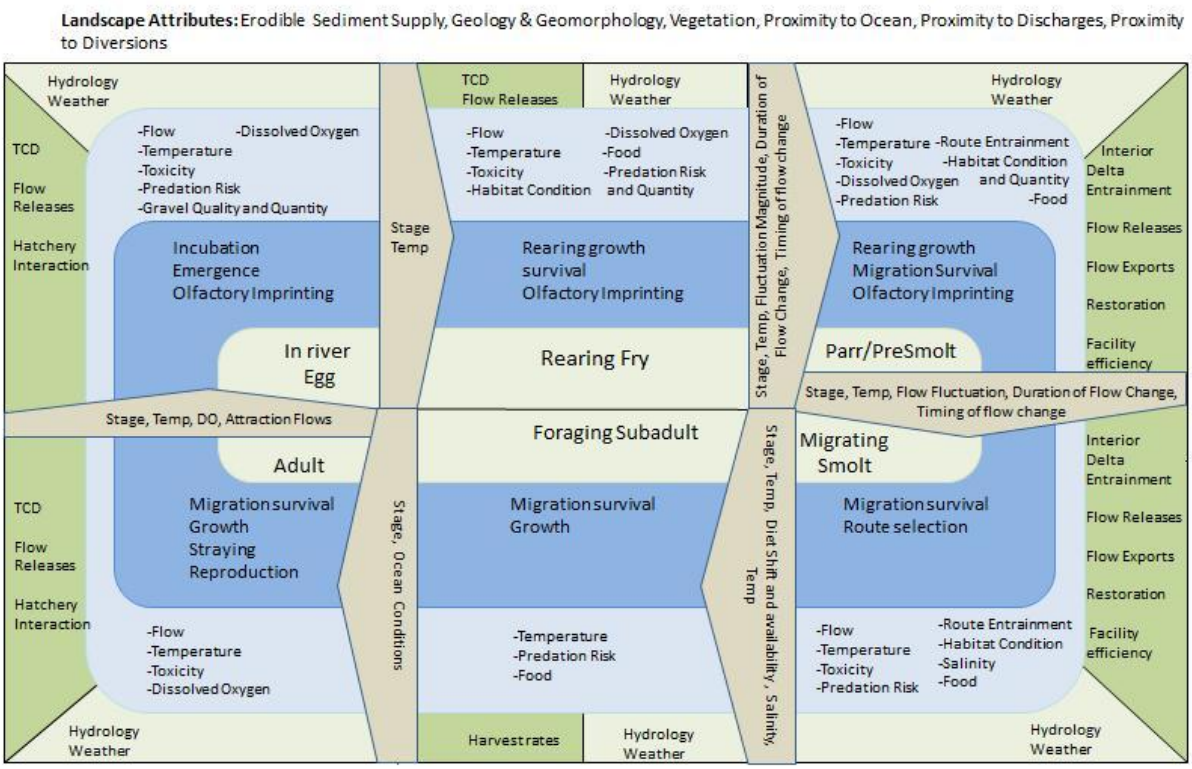


Figure 1. Conceptual Model for Central Valley Salmonids. The center are life stages nested in tiers representing biological responses, habitat attributes, and environmental and management drivers. Landscape attributes are representative of spatially diverse characteristics that can modify habitat attributes regionally. The grey arrows across tiers linking life stages represent transitional habitat attributes.

Winter-run Chinook salmon

Sacramento River winter-run Chinook salmon were originally listed as threatened in August 1989, under emergency provisions of the Federal Endangered Species Act (ESA), and formally listed as threatened in November 1990 (55 FR 46515). The National Marine Fisheries Service (NMFS) designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). They were reclassified as endangered on January 4, 1994 (59 FR 440) due to increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 and 1993, and a 99 percent decline between 1966 and 1991.

Life History

Adult winter-run Chinook salmon return to freshwater during the winter but delay spawning until the spring and summer. Juveniles spend about 5 to 9 months in the river and estuary systems before entering the ocean. This life-history pattern differentiates the winter-run Chinook from other Sacramento River Chinook -runs and from all other

populations within the range of Chinook salmon (Hallock and Fisher 1985, Vogel and Marine 1991).

Adult winter-run Chinook salmon leave the Pacific Ocean and enter San Francisco Bay from November through May or June in an immature reproductive state. Fish proceed upstream and migrated passed Red Bluff begins in mid-December and may continue into early August. The majority of the run passes Red Bluff from January and May, with peak passage in mid-March (Hallock and Fisher 1985). In general, winter-run Chinook spawn in the area from Redding downstream to Tehama. However, the spawning distribution, as determined by aerial redd surveys is somewhat dependent on the river flow and temperature (Figure 1). It is predicted that spawning distribution moves upriver as ambient warmer water temperatures increase in downriver sections.

Winter-run Chinook spawn from late-April through mid-August with peak spawning in May and June. Fry emergence occurs from mid-June through mid-October. Once fry emerge, juveniles fill slow moving, channel margin habitats. Martin et al. (2001) evaluated brood years (BYs) 1995 through 1999 and found that emergence began in July during all BYs with peak dispersal occurring in September and October (based on RBDD data through 2001) regardless of flow and temperature. From 1995 through 1999, the pre-smolt/smolt emigration (greater than 45 mm fork length) started in September with 100 percent of production passing RBDD 2 to 3 months prior to the next brood year. Between 44 and 81 percent of winter-run production used areas below RBDD for nursery habitat and the relative use above and below RBDD appeared to be influenced by river discharge during fry emergence (Martin et al. 2001). Emigration past Red Bluff (RM 242) may begin in late July, generally peaks in September, and can continue until mid-March in drier years (Vogel and Marine 1991). Juveniles are found above Deer Creek from July through September and spread downstream to Princeton (RM 164) between October and March (Johnson et al. 1992). The emigration of winter-run into the Delta occurs in December through February and distinct emigration pulses appear to coincide with high precipitation and increased turbidity (del Rosario et al. 2013). Scale analysis indicates that winter-run Chinook smolts enter the ocean at an average fork length of about 118 mm, while fall-run smolts average about 85-mm fork lengths (CDFG unpublished data). This suggests that winter-run juveniles reside in fresh and estuarine waters for 5 to 9 months, exceeding freshwater residence of fall-run Chinook by 2 to 4 months. Winter-run smolts are detected leaving the Delta from September to June with a peak in March and April (USFWS trawl data at Chipps Island), which appears to be linked to changes in Delta temperatures or smolt physiological condition.

Winter-run Chinook salmon, like all Central Valley Chinook, likely remain localized primarily in California coastal waters. Coded wire tag (CWT) returns indicate that only 4 percent of winter-run hatchery production recoveries from ocean waters occurred in

Oregon (Regional Mark Information System [RMIS] database). The majority of ocean tag recoveries were from the Monterey Bay, San Francisco Bay, and North Coast regions.

Current Status

Although the escapement estimate of winter-run Chinook salmon in 2014 is not yet available, 1,386 carcasses have been enumerated prior to August 24, 2014 (Doug Killiam, CDFW, pers. comm.). Similar carcass observations in 2007, 2008, and 2012 yielded population estimates between 2,541 and 2,830. This return is larger than the spawning run that produced these fish in the Sacramento River during the summer of 2011 (n= 827). Summer Keswick releases followed an expected pattern and have been decreasing for 6 weeks (Figure 2). Aerial redd surveys detected all of the 2014 winter-run Chinook salmon redds to be upstream of the 2014 temperature compliance point at the Clear Creek temperature monitoring station. Temperatures in the river are exceeding temperature compliance thresholds, while releases are being diverted through the power bypass to access the coolest remaining water in Shasta Reservoir. These temperatures are predicted to increase egg mortality and reduce egg to fry survival. As part of NMFS BiOp Action I.2.2.C, transitioning to a Keswick release of 3,250 cfs as soon as possible is desired to conserve storage.

Winter-run Chinook salmon fry continue to emerge from redds and are starting to be observed in fish monitoring at Red Bluff Diversion Dam. Emergence timing for winter-run was calculated based on water temperatures at the above Clear Creek temperature gauge and the spawning timing from aerial redd surveys. Water temperatures at this location, which is ten miles below Keswick Dam, are very close to those released at Keswick, so they are an accurate approximation of temperatures in the areas of incubating winter-run eggs. Approximately 10% of the alevins are predicted to still be in the gravel at the beginning of October. The majority of the alevin should have emerged from the gravel by October 18, with expected emergence from all redds by November 7.

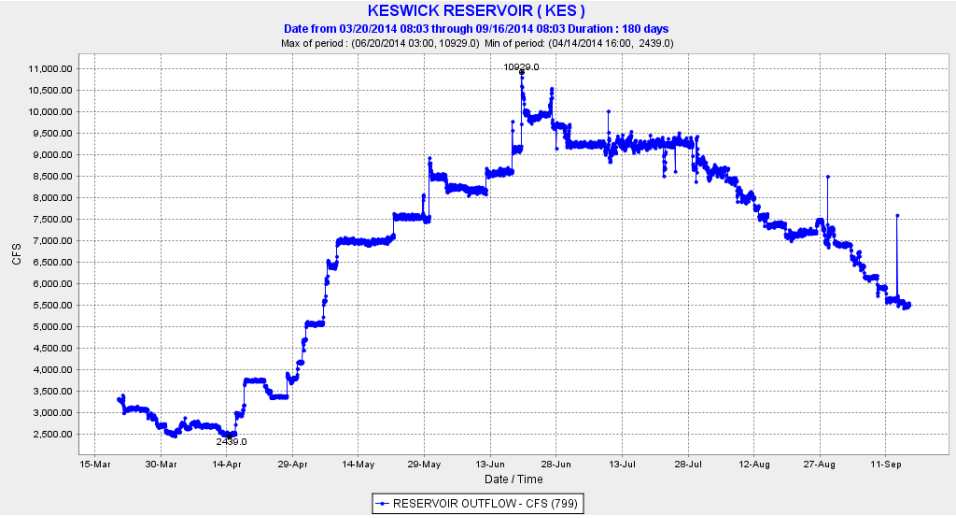


Figure 2. Keswick Reservoir outflow for summer 2014. Downloaded from CDEC on September 16, 2014.

2014 Winter Run Redds - Emergence Timing Estimate

Spawned by date (from aerial survey)	30-Ma	6/5/20	6/12/2(	6/19/2	6/27/2	7/2/20	7/9/20	7/17/2(	7/25/2(	7/31/2(	8/7/2(	22-Au(	
Fry emerged by date (from Sac Abv Clr Crk Water Temps and 1000 ATU's (Celsius)	**13-Aug**	**19-Aug**	**26-Aug**	**2-Sep**	**9-Sep**	**14-Sep**	**21-Sep**	**28-Sep**	**5-Oct**	**11-Oct**	**18-Oct**		
Redds	7	3	15	1	8	30	26	19	8	7	3		No redds
Proportion of redds	6%	2%	12%	1%	6%	24%	20%	15%	6%	6%	2%		
Cumulative redds	7	10	25	26	34	64	90	109	117	124	127		
Cumulative proportion	**6%**	**8%**	**20%**	**20%**	**27%**	**50%**	**71%**	**86%**	**92%**	**98%**	**100%**		
Calculations used actual water temperatures through 9-11-2014 and daily temperature of 14C after 9-11-2014													

Table 1. Winter-run Chinook estimated fry emergence timing in 2014.

Spring -run Chinook salmon

Central Valley spring-run Chinook salmon were listed as threatened on June 18, 2005 (70 FR 37160). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River Basin. Critical habitat was designated for spring-run Chinook on September 2, 2005 (70 FR 52488).

Life History

Spring-run Chinook migration in the upper Sacramento River and tributaries extended from mid-March through the end of July with a peak in late May and early June. Spring-run Chinook are sexually immature when they enter freshwater. Their gonads mature during the summer holding period. Pools in the holding areas need to be sufficiently

deep, cool (about 64 F or less), and oxygenated to allow over-summer survival. Adults tend to hold in pools near quality spawning gravel. CDFG (1998) characterized these holding pools as having moderate water velocities (0.5 to 1.3 feet per second) and cover, such as bubble curtains.

Spring -run Chinook salmon spawning occurs during the first half of September. Eggs are laid in similarly coolwater reaches of the upper Sacramento as winter-run Chinook salmon. Alevin emerge in early winter, and fry rear along channel margins moving downstream with increasing flows. Juvenile spring-run rear in natal tributaries, the Sacramento River mainstem, nonnatal tributaries to the Sacramento River, and the Delta. Emigration timing into the Delta is influenced by flows, temperatures, and turbidity, and thus is variable. Rearing within the Delta occurs principally in tidal freshwater habitats. Juveniles typically do not move into brackish water until undergoing smoltification, which is influenced by temperatures, diel period, and physiological condition.

Current Status

The current spawning run is predicted to be larger than the spawning run that produced these fish in the Sacramento River during the summer of 2011 due to a cohort replacements rate greater than 1 being observed in other ESUs. Preliminary information supports this increase occurring across the population in monitoring on the Feather River and Battle, Clear, Mill, and Deer creek (Matt Brown, USFWS; Ryon Kurth, DWR; Jason Roberts, CDFW, pers. comm.). However, since 2009 spring-run Chinook salmon escapement is not distinguished from fall-run Chinook escapement in the upper Sacramento River (CDFW 2014). This is due to the difficulty in identifying spring-run Chinook from fall-run Chinook salmon in carcass and redd surveys used to enumerate fish. Spring-run Chinook are beginning to spawn in 2014 in natal watersheds including the upper Sacramento River. Spring-run Chinook salmon fry will emerge in late November, when they are predicted to be first observed at Red Bluff Diversion Dam. Increased emigration past fish monitoring at Red Bluff Diversion Dam is highly variable (Figure 3).

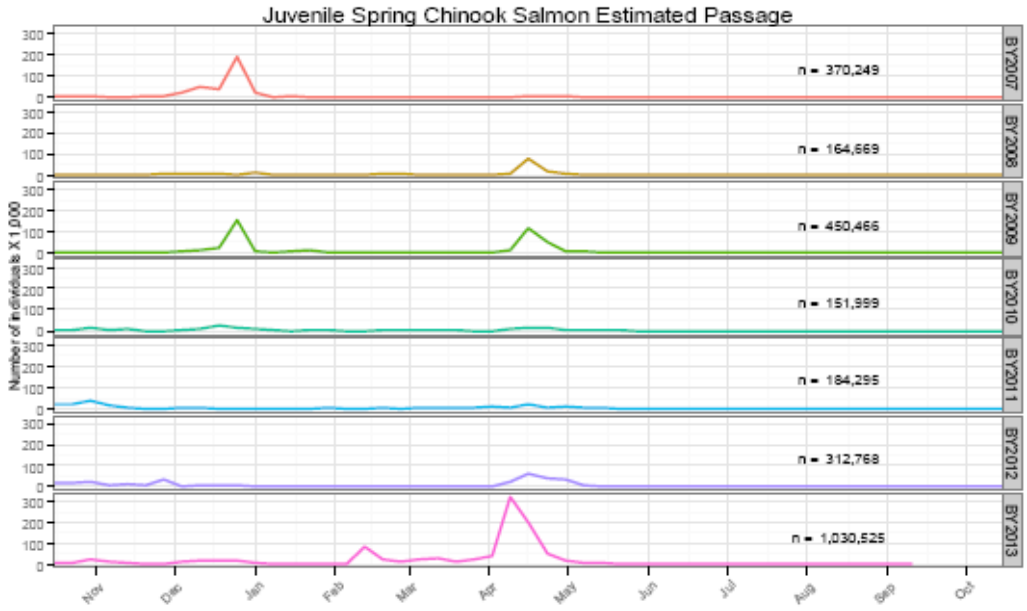


Figure 3. Weekly estimated passage of juvenile spring -run Chinook salmon at Red Bluff Diversion Dam (RM244) by brood year (BY). Fish were sampled using rotary-screw trap for the period October 16, 2007 to Present. No spring run Chinook juveniles have past yet in 2014. Figure supplied by USFWS on September 10, 2014.

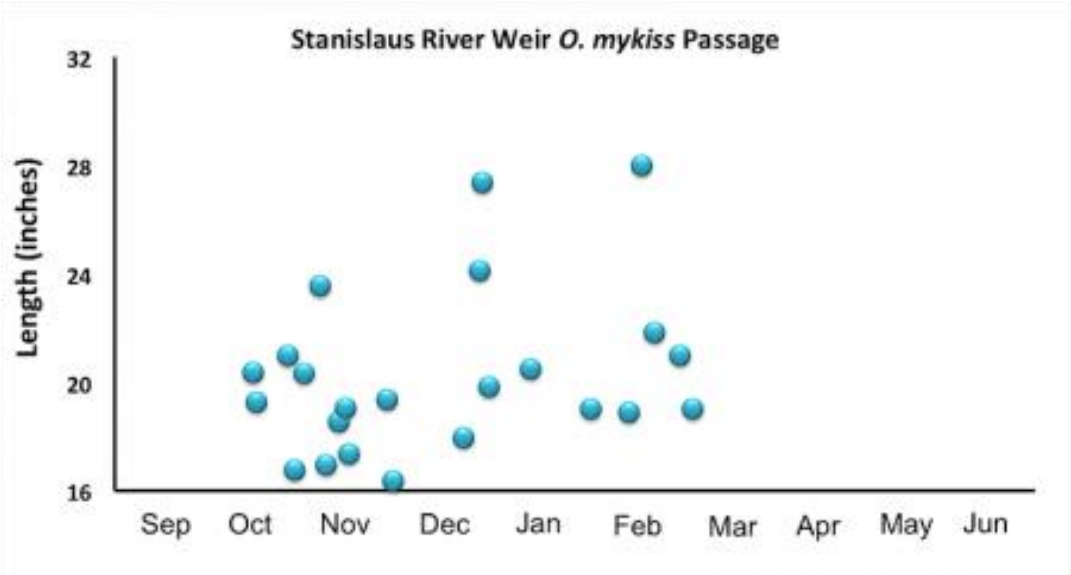
Steelhead

Central Valley steelhead were listed as threatened under the Endangered Species Act (ESA) on January 5, 2006 (71 FR 834). This Distinct Population Segment (DPS) consists of steelhead populations in the Sacramento and San Joaquin River (inclusive of and downstream of the Merced River) basins in California's Central Valley. Critical habitat was designated for Central Valley steelhead on September 2, 2005 (70 CFR 52488). Steelhead share similar biological responses to habitat attributes and exposure to environmental and management drivers as salmon provided in Figure 1.

Life History

CV steelhead generally leave the ocean from August through April (Busby *et al.* 1996), and spawn from December through April, with peaks from January through March (Hallock *et al.* 1961, McEwan and Jackson 1996). Specific cues triggering steelhead to return to their spawning grounds from the Pacific Ocean are not well understood. The ability for steelhead to find their natal streams for spawning is likely similar to Chinook, which is related to their long-term olfaction memory and vision (Healey 1991) and may be stimulated by higher stream flow and changes in water turbidity, temperature and oxygen content (Allen and Hassler 1986). Based on numerous studies, avoidance behavior and migration blockage may occur at daily average temperatures of 21-24°C (69.8-75.2°F) (WDOE 2002). Timing of upstream migration is correlated with higher

flow events, such as freshets. Unlike Pacific salmon, steelhead are iteroparous (capable of spawning more than once before dying) (Barnhart 1986, Busby *et al.* 1996). Returning steelhead to the Stanislaus and Central Valley tributaries tend to range from 16[1] to 28 inches (Figure 4).



.

Figure 4. Steelhead (n=23) in Stanislaus River Weir Counts 2003-2011 (FishBio 2012)

According to McEwan (2001), peak spawning for Central Valley winter-run steelhead occurs from December through April but can "possibly [extend through the] early summer months." USEPA (2003) recommended water temperatures for spawning, egg incubation, and fry emergence are a 7 day average of the daily maximum values (7-DADM) less than 55°F. The length of time for eggs to hatch is dependent on water temperatures but takes 30 days at 51°F (hatchery conditions). Fry emergence typically occurs about 4 to 6 weeks after hatching, dependent on redd depth, gravel size, siltation, and temperature (Shapovalov and Taft 1954). Newly emerged fry move to the shallow, protected areas associated with stream margins (McEwan and Jackson 1996) and soon move to other areas of the stream and establish feeding locations (Shapovalov and Taft 1954).

Steelhead over-summer rearing often occurs in higher velocity areas in pools, but young-of-the-year are also abundant in glides and riffles. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991). Juvenile CV steelhead

[1] Steelhead defined as *O. mykiss* greater than 16 inches (CDFG 1996).

feed mostly on drifting aquatic organisms and terrestrial insects and will also take active bottom invertebrates (Moyle 2002).

Juvenile steelhead emigrate from natal streams during winter and spring; often during freshet or high flow events. Smolts are observed in rotary screw traps at Knights Landing between December and May and in the Delta (Sacramento and Chipps Island Trawl) between December and June. Throughout the Central Valley, the majority of juvenile *O. mykiss* do not migrate to the ocean, but remain in freshwater and spawn as resident trout (Poytress et al 2014, Satterthwaite et al 2010, Lindley et al 2007). Emigrating CV steelhead use the Delta primarily as a migration corridor to the ocean. However, some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas prior to their final emigration to the sea.

Current Status

Lower San Joaquin River and Stanislaus River

Upstream migrating adult steelhead may enter the San Joaquin River basin directly from the Delta through the mainstem or may use alternate South Delta waterways and enter the San Joaquin River through the Head of Old River near Mossdale. Data in the Lower San Joaquin River and Delta are lacking regarding adult migration, but upstream passage data collected annually since 2003 in the Stanislaus River provides an indication of approximate migration timing through the lower San Joaquin River. Stanislaus River weir data indicate that steelhead migrate upstream, through the South Delta and lower San Joaquin river, between September and March with numbers ranging from 6 to 85[2] between 2008-2011 and 2013. Prior to November 15 an average 21% of *O. mykiss* migrants were recoded swimming upstream passed the Stanislaus weir (Figure 5).

According to CDFW (CDFG 2003, as cited by NMFS 2009), it is "clear from [Mossdale] data that rainbow trout do occur in all the tributaries [i.e., Stanislaus, Tuolumne, and Merced rivers] as migrants and that the vast majority of them occur on the Stanislaus River". Central valley steelhead are present in the Stanislaus River year round. Outmigrating steelhead smolts enter the Delta from the San Joaquin River basin at Mossdale typically between March and May with none recorded earlier than during January (Figure 6). In the absence of the Head of Old River Barrier (HORB), steelhead smolts exiting the San Joaquin River basin can follow either of two routes through the Delta. Fish may either stay in the mainstem of the San Joaquin River and move northwards towards the Port of Stockton and the Central Delta, or they may enter the South Delta through the Head of Old River and move northwards towards the lower San

[2] Note: numbers available are for all *O. mykiss* passing upstream of the Stanislaus Weir and do not differentiate between adult steelhead (as defined by CDFG 1996) and rainbow trout resident fish that are moving within the tributary; therefore, numbers of steelhead may be lower than those presented.

Joaquin River through Old and Middle rivers and their associated network of channels and waterways. When the springtime HORB is not installed, a high proportion of the San Joaquin River flow is directed into Old River (i.e., 50 percent or greater dependent on export conditions). Under low flow conditions with high pumping rates, the net flow in the mainstem of the San Joaquin between the Port of Stockton and Old River may reverse direction and flow upstream into the Head of Old River. When the springtime HORB is installed, flow in the San Joaquin River is retained in the mainstem and fish are directed northwards towards the Port of Stockton and eventually through the Central Delta. In the Central Delta, net flow in the mainstem of the San Joaquin River between the Port of Stockton and Jersey Point can flow upstream through Turner and Columbia Cuts, as well as, other connections towards the export facilities.

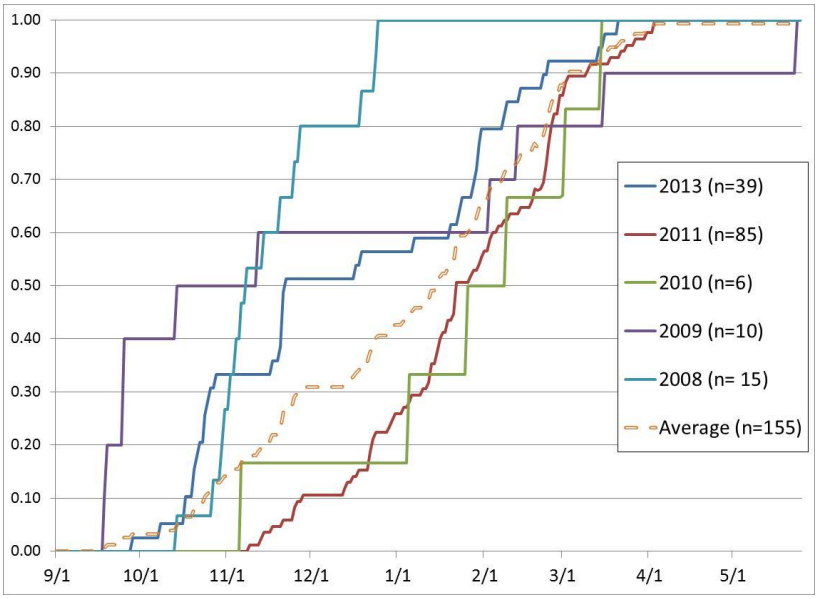


Figure 5. Cumulative proportion of steelhead passing the Stanislaus Weir during five recent years. Information provided by FishBio.

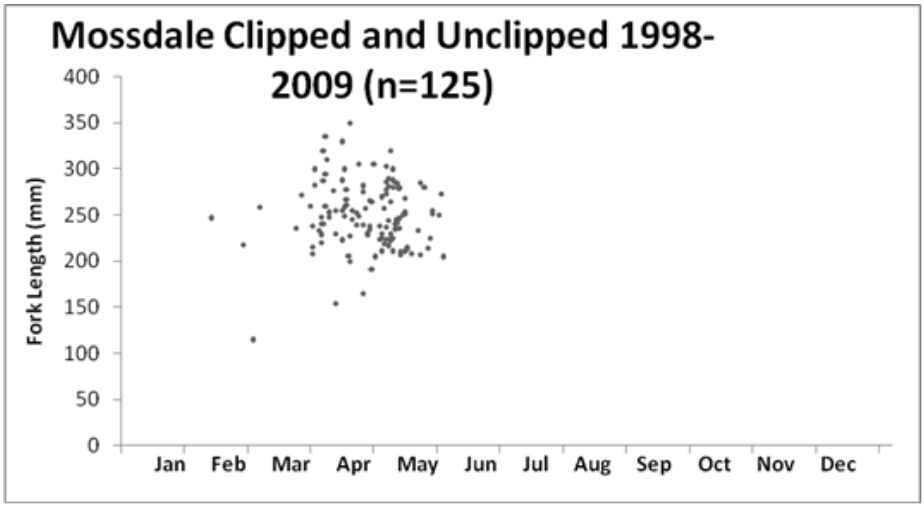


Figure 6. Fork length by date of clipped and unclipped juvenile steelhead captured in the USFWS and CDFG Mossdale trawl fish monitoring study.

American River

Central valley steelhead are present in the American River year round. During the October through November period, juveniles are rearing throughout the reach of the river from Nimbus Dam down to Paradise Beach (river miles 5 to 23). The entire 2014 year class of juvenile steelhead from Nimbus Hatchery was released into the river in early June in anticipation that temperatures in the hatchery would reach levels not conducive to raising healthy steelhead. Hatchery produced steelhead from Nimbus Hatchery are not considered to be a part of the Central Valley steelhead DPS but the naturally spawning fish are included in the DPS. Sampling by CDFW over the summer has found that the juvenile steelhead population rearing in the river is now dominated by the fish from the early hatchery release and that the hatchery fish are larger. During the summer and fall the juvenile steelhead utilize primarily riffle habitats in the American River. The extent of riffle habitat is reduced as flows drop within the expected range of flows this fall (approximately 800 cfs to 1,400 cfs). Adult steelhead begin to enter the American River in November and hold before early spawning begins in late December.

Sacramento River

Adult steelhead are migrating upstream in the Sacramento River in the October – November water transfer period. They spawn in the winter, based on the spawning timing at Coleman Hatchery. The Sacramento River has a large resident trout population that spawns later than steelhead based on the timing of young of year *O.mykiss* passing the rotary screw traps at Red Bluff (Figure 7). The peak in *O.mykiss* catch appear related more to young juveniles rearing in the river in the vicinity of Red Bluff soon after emergence than fish emigrating to the delta and ocean. Juvenile steelhead rear in the river year round and, similar to salmon, emigrate towards the Delta rapidly during flow pulses.

Green Sturgeon

On April 7, 2006, NOAA's National Marine Fisheries Service (NMFS) issued a final rule listing the Southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*) (green sturgeon) as a threatened species, which took effect on June 6, 2006 (71 FR 17757).

Life History

Adult green sturgeon emigrate through the Delta and into the upper Sacramento River through the Delta from March to June to spawn. They broadcast spawn in a very limited segment of the Sacramento River in May and June and also in the Feather River during

wet years. Eggs adhere to hard substrates, then after hatching into larvae drift into slow-moving, deep water habitats. Juveniles rear in similar habitats adjacent to shallow channel margins habitats. Juveniles older than nine months can rear in freshwater and/or brackish tidal habitats for up to three years. Information on green sturgeon is extremely limited and their recovery in current fish monitoring efforts is limited.

Current Status

In 2014, multiple acoustically tagged adult green sturgeon have been recorded in the Sacramento River between Deer Creek and RBDD. In 2014, fewer juveniles were observed at RBDD (n=318) than the long-term average of 426 fishes (1996-2013). Green sturgeon observations are extremely rare in the Delta and none have been observed in other Sacramento River or Delta fish monitoring surveys or at the state and federal fish collection facilities at the South Delta CVP/SWP export pumps during WY 2014. In 2011, over a thousand juvenile green sturgeons were enumerated at RBDD although none were observed in river, Delta, or Bay fish monitoring efforts. Based on Israel and Klimley (2009), over summer in the upper Sacramento River and in October and November typically the juvenile green sturgeon are predicted to remain close to their natal spawning areas.

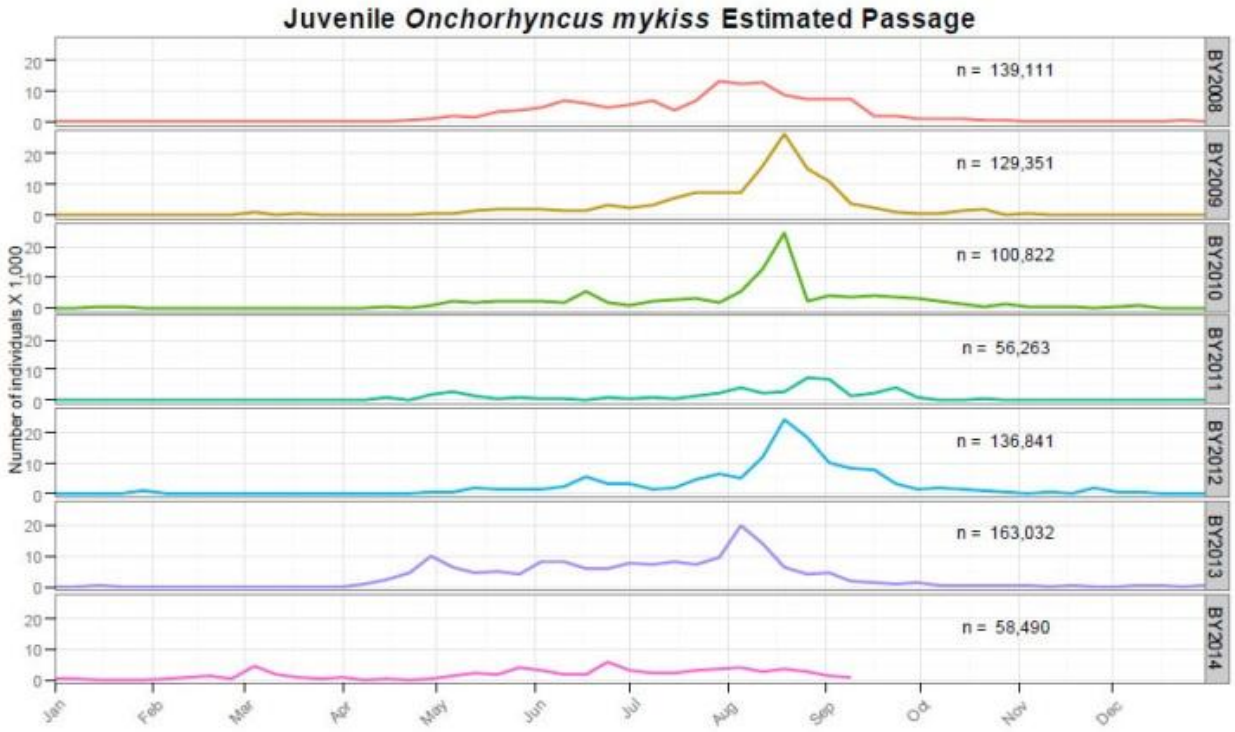


Figure 3. Weekly estimated passage of juvenile Rainbow/Steelhead trout at Red Bluff Diversion Dam (RK391) by brood-year (BY). Fish were sampled using rotary-screw traps for the period January 1, 2008 to present.

Figure 7. Timing and abundance of O.mykiss captured at Red Bluff rotary screw traps, 2008 – 2014. Figure provided by USFWS on September 10, 2014.

Analytical Framework

To evaluate impacts to listed species (Table 2) due to tributary flow changes and Delta exports caused by the Proposed Action, relevant peer-reviewed literature on these factors and fish biology, behavior, and survival are reported. We discuss effects within the tributaries using currently available species distribution and abundance data along with expected life stage periodicity information and make comparisons to projected flow and operational conditions. Where available, spawning timing and distribution was used to estimate fry emergence timing based on past and estimated near future incubation temperatures.

Species	Status	Life stages in Action Area
Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*)	FT,ST	Adults, eggs
Sacramento River winter- -run Chinook salmon (*Oncorhynchus tshawytscha*)	FE,SE	Eggs, fry
Central Valley Steelhead (*Oncorhynchus mykiss*)	FT	Parr, adults
North American Green Sturgeon (*Acipenser medirostris*), Southern Distinct Population Segment	FT	Juveniles

Table 2. Listed species life stages present in the Proposed Action Area.

Biological Analysis of Action

Winter-run Chinook salmon

Mainstem Habitat Effect

The Proposed Action's Shasta Reservoir water transfer will augment flows in the Sacramento River between October 1 and as late as November 15. These flows will occur while WRCS eggs are still incubating, and thus reduce the likelihood of redd dewatering. Current 30-day weather forecast predict continued warm temperature with an equal chance of above normal, normal, and below normal precipitation over the Central Valley (NOAA 2014). If these conditions persist, 100 % of the winter-run Chinook salmon fry will continue to rear in the Sacramento River upstream of Knights Landing. Flow augmentation for the water transfers from Shasta Reservoir is likely to maintain flows between 3250 and 6000 cfs. Thus, releases will not exceed flow thresholds (>12,000 cfs at Wilkins Slough) observed to trigger outmigration of winter-run Chinook salmon past Knights Landing (del Rosario et al. 2013). Thus, the Proposed Action is not predicted to influence key biological responses of winter-run Chinook salmon such as migration cues,

redd dewatering, egg or rearing survival, or rearing growth (Figure 1). There is a moderate level of uncertainty in these conclusions based on uncertainty in the weather.

Delta Effect

The Proposed Action will augment exports between October 1 and November 15, and are forecast to be between 3000 and 4000 cfs combined exports. These export rates are within those analyzed in the NMFS BiOp. The Proposed Action will continue to implement NMFS BiOp Actions IV.1 and IV.3 regarding the Delta Cross Channel gate operations and export reductions, utilizing identified spatially-independent catch indices and daily salvage information, respectively. Current 30-day weather forecast predict continued warm temperature with an equal chance of above normal, normal, and below normal precipitation over the Central Valley (NOAA 2014). If these conditions persist, 100 % of the winter-run Chinook fry will continue to rear in the Sacramento River upstream of Knights Landing and will not trigger RPA Action IV.1 biological thresholds. The Proposed Action's export forecasts are less than export responses (RPA IV.3 export range 4,000 to 6,000) once biological triggers (daily loss, density, or CWT recovery rate) are exceeded, thus Proposed Action is unlikely to impact implementation of the RPA . Since winter-run Chinook salmon are not predicted to migrate out of the Sacramento River, the Proposed Action is not predicted to adversely influence key biological responses such as rearing growth, migration survival or interior Delta route entrainment (Figure 1). There is a low level of uncertainty in these conclusions based on implementation of the NMFS BiOp RPA protecting winter-run Chinook salmon from entrainment into the Interior Delta or South Delta export facility exposure.

Spring -run Chinook Salmon

Mainstem Habitat Effect

The Proposed Action's Shasta reservoir water transfer will augment flows in the Sacramento River between October 1 and November 15. These flows will occur while spring-run eggs are still incubating, and thus reduce the likelihood of redd dewatering. Current 30-day weather forecast predict continued warm temperature with an equal chance of above normal, normal, and below normal precipitation over the Central Valley (NOAA 2014). Regardless of these conditions, 100% of spring-run eggs will continue to incubate in the Sacramento River upstream of Red Bluff Diversion Dam. Flow augmentation for the Shasta Reservoir water transfers is likely to maintain flows between 3250 and 6000 cfs. Thus, the Proposed Action is not predicted to influence key biological responses of mainstem spring-run Chinook salmon such as migration cues, redd dewatering, or egg survival (Figure 1). There is a low level of uncertainty in these predictions based on spring-run Chinook being in redds during the action.

Delta Effect

The Proposed Action will augment exports during October to November 15, although these are forecast to be between 3000 and 4000 cfs combined exports. These volumes are within the effects described in the NMFS BiOp. The Proposed Action will continue to implement NMFS BiOp Actions IV.1 and IV.3 regarding the Delta Cross Channel Gate Operations and Export reductions utilizing identified spatially-explicit Catch Indices and Daily salvage information, respectively. These actions will continue to be implemented for yearling spring-run Chinook salmon, and thus any effects are within those described in the NMFS BiOp. Since young-of-the-year spring-run Chinook salmon will remain in the gravel during this period, the Proposed Action is not predicted to interact with these fish and influence any key biological responses in the Delta. There is a low level of uncertainty in these conclusion based on the distribution of the species.

Central Valley Steelhead

Tributary Habitat Effects

American River

The base flow in the American River during October and November 2014 is 800 cfs under the flow management standard as outlined in the RPA. The transfer of water out of Folsom would result in higher flows up to about 1,400 cfs. The flows above the 800 cfs base would increase the availability of rearing habitat for juvenile steelhead. During the fall, juvenile *O. mykiss* rear primarily in riffle habitats which are reduced as flows drop below 1,400 cfs. Current rearing densities have been artificially increased by the early release of the hatchery steelhead. The higher flows would help to reduce crowding due to the increased numbers of juveniles in the river in comparison to what would otherwise be present. Figure 8 shows temperature modeling results of various flow and power scenarios. A power bypass is planned to occur allowing access to colder water below the power intakes that otherwise would be available for release. The power bypass provides significantly cooler temperatures, and is predicted to provide temperatures below 60°F by late October in all scenarios, benefitting juvenile and adult steelhead. Reclamation will work with fishery agencies to achieve a fish friendly flow pattern while still meeting the purpose of the water transfer. The effect of the release schedule in the American River to accommodate the water transfer along with the temperature management operation is predicted to benefit Central Valley steelhead on the American River through an increase in rearing habitat availability provided by the higher flows. There is low level of uncertainty in this prediction based on the flow-habitat relationship.

Resident *O. mykiss* are present in the American River year round, and adult steelhead enter the river in November. Key biological responses during this life stage such as survival and egg maturation are not predicted to be affected by the Proposed Action's flow augmentation, although greater flows is predicted to increase attraction and reduce

straying into other watersheds over base flow conditions. There is a high level of uncertainty in this adult prediction.

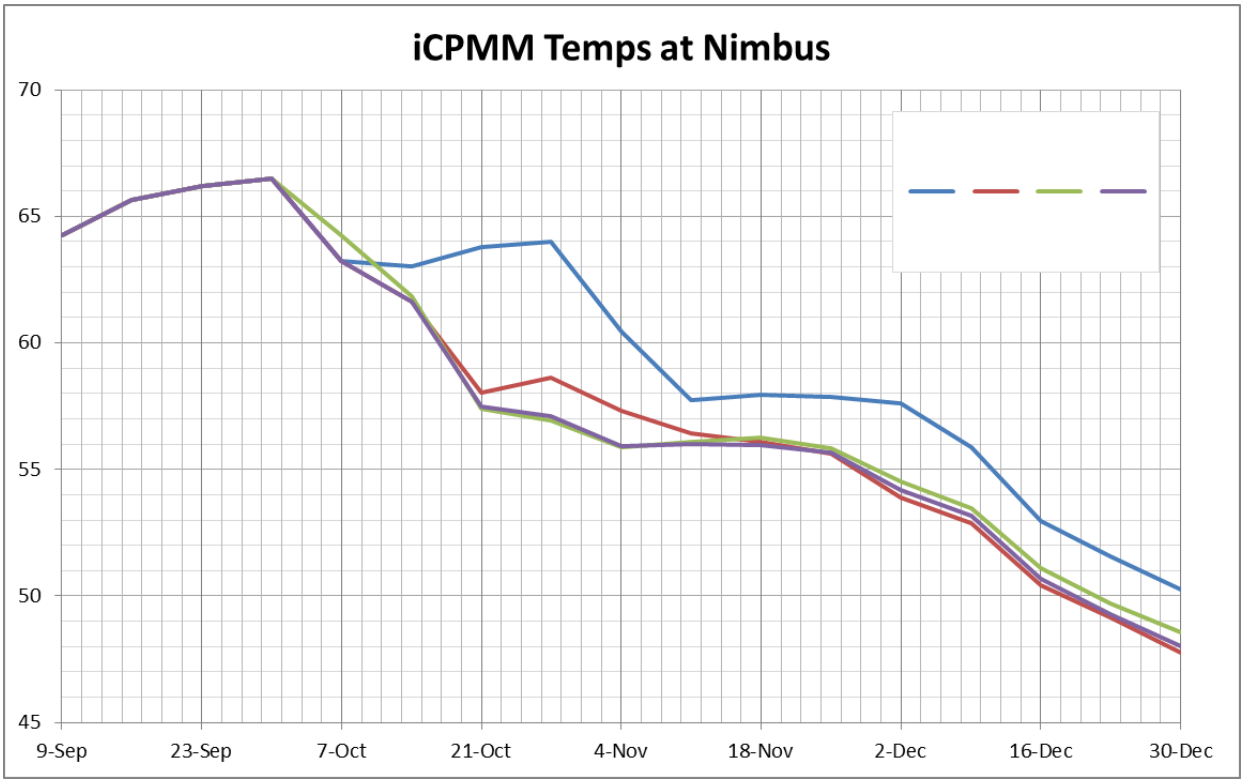


Figure 8. Temperature modeling results of four American River flow scenarios. The blue line shows temperature with no power bypass and the other three scenarios include a power bypass at Folsom.

Sacramento River

Steelhead rearing in the Sacramento River would experience slightly higher flows than would otherwise be present without the Proposed Action. No appreciable effect from these higher flows on steelhead are expected to occur as the flows down to the minimum of 3,250 cfs at Keswick are adequate to support the steelhead population in the Sacramento River.

Attempts to continue water temperature management for Chinook salmon should provide adequate temperatures for steelhead rearing from Keswick downstream to below Red Bluff. The effects to Central Valley steelhead in the Sacramento River are within the range of effects (flows and temperatures) that were analyzed in the NMFS BiOp (NMFS 2009). The Proposed Action is not predicted to adversely affect Central Valley steelhead in the Sacramento River. There is a low level of uncertainty in this conclusion based on

implementation of temperature and flow management as specified in the NMFS 2009 BiOp.

Lower San Joaquin River and Stanislaus River

Due to WY 2014 drought conditions, unfavorable environmental attributes (e.g., low dissolved oxygen in the southeastern Delta and Lower San Joaquin River, high water temperatures influenced by ambient air temperatures,) may limit or delay migration regardless of the Proposed Action. There is no specific information regarding steelhead response to dissolved oxygen (DO) conditions; however, Hallock et al (1970) observed fall run Chinook migration not increasing until dissolved oxygen levels were greater than 5ppm and temperatures were less than 66°F. Although steelhead may respond to DO similarly, fall-run Chinook salmon are generally poor surrogates for steelhead, which exhibit a greater temperature tolerance range (i.e., migration at temperatures less than 68°F) as well as spawn later in the winter (McEwan and Jackson 1996). Both of these attributes suggest steelhead are physiologically flexible enough to begin their upstream migration until reasonable conditions are available. There is a high level of uncertainty in these predictions since there is little specific information about dissolved oxygen and temperature projections and the prediction is based partially on surrogate information.

Under existing water year conditions, water temperatures in the southeastern Delta and lower San Joaquin and Stanislaus River may also further limit or delay migration regardless of the Proposed Actions. Water temperature is highly dependent on ambient air temperatures. The current 30-day weather forecast predict continued warm temperature with an equal chance of above normal, normal, and below normal precipitation over the Central Valley (NOAA 2014). If weather conditions persist, steelhead are not expected to benefit from greater flows than provided by the Proposed Action in the San Joaquin River until later in October or early November because water temperatures through the Lower San Joaquin River and its tributaries will be restrictive. As such, the operational flexibility afforded by the Proposed Action will allow the fisheries agencies to recommend a range of possible initiation dates between October 1 and October 16 resulting in an implementation period that will be the most beneficial for adult steelhead migration and spawning relative to given warm water temperatures. The timing of upstream migration opportunities through the lower San Joaquin River should consider the likelihood that water temperatures would be suitable for spawning upon arrival into spawning areas. Suitable water temperature projections are based on forecasted ambient air temperatures and precipitation. For instance, the fisheries agencies may recommend the earliest implementation period (i.e., October 1- October 31) be employed if ambient air temperatures in the tributaries begin cooling earlier than

expected and precipitation forecasts indicate early rains. Conversely, the latest implementation period (i.e., October 16-November 15) may be recommended if ambient air temperatures continue to remain high and no precipitation is forecast.
Although the monthly average flows at Vernalis (in the Lower San Joaquin River) will be reduced by 200 cfs, implementation of Stanislaus River flow releases to meet NMFS BiOp (2009, 2011) RPA Action III.1.3 Schedule 2E flow requirements will result in two attraction pulse flows designed to improve upstream migration conditions for steelhead. These pulse flows, combined with the HORB being in place during the same period, may improve steelhead migration opportunities and water quality in the lower San Joaquin River given the drought conditions within the basin.

The Proposed Action will reduce the average month-long fall attraction base flow in the lower San Joaquin River (as measured at Vernalis) from 1,000 cfs to 800 cfs for 31 days. However, the Proposed Action provides flexibility during the implementation time frame, which improves the ability to meet fisheries needs under current drought conditions. The release schedule will be established according to recommendations of the fisheries agencies, ranging between October 1 and November 15. New Melones releases will be made during this period as recommended by the fisheries agencies to meet the NMFS BiOp (2009, 2011) RPA Action III.1.3 Schedule 2E flow requirements. Key biological responses of migrating steelhead that may be affected by the Proposed Action include straying and reduced egg viability.

The Stanislaus River contributes the majority of flows observed at Vernalis under dry year conditions; therefore, lower flows from other tributaries will reach Vernalis under the Proposed Action conditions and cumulatively result in similar proportions of flow from the Stanislaus River and other San Joaquin River tributaries. The range of differences in the hydrodynamic conditions associated with a reduction of 200 cfs under the Proposed Action is unlikely to have a measureable effect on the proportional source of waters reaching Vernalis. During the Proposed Action, the majority of water for any migrating steelhead to cue in on for migration will be from the Stanislaus River since little water is expected to reach Vernalis from other San Joaquin River tributaries. Thus, the flows provided under the Proposed Action are not predicted to have a measureable effect on straying adult Stanislaus steelhead. There is moderate uncertainty in this prediction based on weather forecasts and other current projected tributary flow operation. Also, there is uncertainty in the number of adult steelhead attempting to return to the lower San Joaquin River this year.

Female steelhead migrate while egg development is occurring and thus there is potential for reduced egg viability due to exposure to warmer temperatures. However, the Proposed Action is not predicted to result in measureable temperature-related effects to

egg viability. There is low uncertainty in this prediction since reduced egg viability in female steelhead associated with high water temperatures have not been observed in the San Joaquin River basin. Based on historical Stanislaus River weir data, it is predicted that adult migration occurring between October 1 and November 15 will account for approximately 20% of WY 2015 total escapement; therefore, the proportion of the migrating population that could possibly experience reduced egg viability or straying is considered low. Lower rates of migrants are also predicted because thermal conditions associated with ambient air temperatures are unlikely to be conducive for migration during much of this period. Since the proportion of adults migrating during this period is highly variable (5 to 80 percent) there is high uncertainty in this prediction.

Juvenile steelhead are not expected to be in the lower San Joaquin River during October and November and any juvenile steelhead rearing in the Stanislaus River have already been over summering under lower flow (approximately 200 cfs) and higher temperature conditions than will be experienced under the Proposed Action; therefore, key biological responses such as rearing and juvenile migration and survival are predicted not be affected.

Delta Habitat Effect

Adult steelhead may move upstream through the Delta during the Proposed Action. The water transfer will result in increased flows into the Delta from the Sacramento River, so there may be a slight increase in attraction flow for steelhead heading up the Sacramento River. If significant rain with runoff into the Delta occurs then juvenile steelhead could begin an early emigration into the Delta. Considering the dry scenario this is unlikely, but if it occurs then existing biological opinion criteria and triggers would be in effect (potential DCC closure and pumping limited to 4,000 cfs) to limit effects on juvenile steelhead.

The effects on steelhead in the Delta are within the range of effects (flows and exports) that were analyzed in the 2009 Biological Opinion and no additional effects are predicted. There is a low level of uncertainty in this conclusion based on knowledge of the habitats currently be using by steelhead and on adherence to the measures in the biological opinion.

Conclusion

Cumulatively, extension of the Transfer Window and modification to the D-1641 Vernalis flow criteria are not predicted to have any adverse effect on any ESA-listed species occurring in the Action Area's tributaries or Delta. Effects on these species in the Delta are within the effects analyzed in the NMFS and USFWS Biological Opinions (NMFS 2009, 2011, USFWS 2008).

Key biological responses of juvenile winter-run Chinook salmon, spring-run Chinook salmon, green sturgeon, and steelhead are not impacted by the augmented flows and greater exports operations as part of the Extended Transfer Window action. NMFS BiOp (2009) flow RPA actions on the Stanislaus and Delta operational criteria for exports and DCC gates will be implemented in consultation with fish agencies. The productivity of winter-run Chinook salmon may be positively affected by the Proposed Action since increased reservoir releases downstream of Keswick Reservoir may increase juvenile production due to increased rearing habitat. However, this effect is likely to be overshadowed by temperature effects associated with difficulty controlling water temperature downstream of Shasta Reservoir. These temperature effects, not associated with the Proposed Action, are likely to substantially impact spring-run egg survival, although the Proposed Action's flow releases may reduce dewatering of spring-run redds. Critical habitat for ESA-listed salmonid and green sturgeon will not be modified by the Proposed Action.

The spatial structure and diversity of steelhead may benefit from the Proposed Action due to the increased rearing habitat for juvenile steelhead in the Sacramento River and American River created by flow augmentation over the base flows expected in these rivers between October 1 and November 15 under releases are reduced as part of drought operation requirements in the NMFS Biological Opinion's Action I.2.2.c. Juvenile steelhead on the Stanislaus will benefit from rearing habitat under the NMFS BiOp RPA Action III.1.3 Schedule 2E flows, while adult migrating steelhead through the Delta and the Lower San Joaquin River are not predicted to have increased straying or reduced egg viability. The reduced flows and modified timing of flows as part of the modification in the D-1641 Vernalis flow criteria is not predicted to influence attraction flows in the Lower San Joaquin River, since the reduced volume will not influence the proportion of San Joaquin River flows entering the Delta and other Delta habitat attributes are predicted to restrict migration into the San Joaquin due to environmental drivers (i.e. weather).

References

Allen, M.A. and T.J. Hassler. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates. (Pacific Southwest), Chinook salmon. U.S. Fish and Wildlife Report 82 (11.49). April.

Barnhart, R.A. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest), steelhead. U.S. Fish and Wildlife Service, Biological Report 82 (11.60). 21 pages.

Busby, P.J., T.C. Wainwright, G.J. Bryant., L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho,

Oregon and California. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Technical Memo NMFS-NWFSC-27. 261 pages.

CDFG [California Department of Fish and Game]. 1998. A status review of the spring run Chinook salmon in the Sacramento River drainage. Report to the Fish and Game Commission. Candidate species status report 98-1. Sacramento, California. June. 394 pages.

CDFW [California Department of Fish and Wildlife]. 2014.GrandTab 2014.04.22 California Central Valley Chinook Population Report. Fisheries Branch, Anadromous Resources Assessment. Downloaded on September 17, 2014 from https://www.dfg.ca.gov/fish/Resources/Chinook/CValleyAssessment.asp

del Rosario, R., Redler, Yvette J., Newman, K., Brandes, P.L., Sommer, T., Reece, K. Vincik, R. 2013. Migration Patterns of Juvenile Winter-run-sized Chinook Salmon (*Oncorhynchus tshawytscha*) through the Sacramento–San Joaquin Delta. San Francisco Estuary and Watershed Science, 11(1).

FishBio. 2012. California Central Valley Steelhead. Fish Biology and Behavior Blog. MONDAY, JANUARY 30, 2012. Accessed 09/18/14 at http://fishbio.com/field-notes/fish-biology-behavoir/california-central-valley-steelhead

Hallock, R.J., W.F. Van Woert, and L. Shapovalov. 1961. An evaluation of stocking hatchery reared steelhead rainbow trout (*Salmo gairdnerii gairdnerii*) in the Sacramento River system. California Department of Fish and Game. Fish Bulletin No. 14. 74 pages.

Hallock, R.J., and F.W. Fisher. 1985. Status of winter-run Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento River. Report to the California Department of Fish and Game, Anadromous Fisheries Branch, Sacramento, California.

Healey, M. C. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). *In* C. Groot and L. Margolis, editors, Pacific Salmon Life Histories. University of British Columbia Press, Vancouver, British Columbia. 564 pages.

Israel, J.A. and A.P. Klimley, 2009. Life History Conceptual Model North American Green Sturgeon (*Acipenser medirostris*). Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan. 49 p.

Johnson, R. R., D. C. Weigand, and F. W. Fisher. 1992. Use of growth data to determine the spatial and temporal distribution of four runs of juvenile Chinook salmon in the Sacramento River, California. Report No. AFF1/FRO-92-15. U.S. Fish and Wildlife Service, Northern Central Valley Fishery Resource Office, Red Bluff, California.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson. 2007. Framework for assessing viability of threatened and endangered Chinook salmon

and steelhead in the Sacramento-San Joaquin basin. *San Francisco Estuary and Watershed Science* **5**(1): Article 4, pp. 1–26.

Martin, C.D., P.D. Gaines, and R.R. Johnson. 2001. Estimating the abundance of Sacramento River juvenile winter Chinook salmon with comparisons to adult escapement. Red Bluff Research Pumping Plant Report Series, Volume 5. U.S. Fish and Wildlife Service, Red Bluff, California.

McEwan, D. 2001. Central Valley Steelhead in Contributions to the biology of Central Valley salmonids. R.L.Brown (ed.), CDFG, 1-43.

McEwan, D. and T. A. Jackson. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game. Sacramento, California. 234 pages.

Meehan, W. R. and T. C. Bjornn. 1991. Salmonid distributions and life histories. *In* W. R. Meehan, editor, Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, pages 47-82. American Fisheries Society Special Publication 19. American Fisheries Society. Bethesda, Maryland. 751 pages.

Moyle, P.B. 2002. Inland fish of California, 2nd edition. University of California Press, Berkeley, California.

NMFS 2009. Biological opinion for the long-term operations of the Central Valley Project and State Water Project. National Marine Fisheries Service. Southwest Region, Long Beach, California. June 4, 2009. 844 pp + appendices.

NMFS. 2011. Amendments to the 2009 biological opinion for the long-term operations of the Central Valley Project and State Water Project. National Marine Fisheries Service. Southwest Region, Long Beach, California. April 7, 2011. 189 pp.

NOAA 2014. Prognostic Discussion for Long-Lead Seasonal Outlooks. http://www.cpc.ncep.noaa.gov/products/predictions/long_range/fxus05.html. Downloaded on September 15, 2014.

Poytress, W.R, J.J. Gruber, F.D. Carillo, and S.D. Voss. 2014. Compendium report of Red Bluff Diversion Dam Rotary Trap Anadromous Fish Production Indices for Years 2002-2012. Report of the U.S. Fish and Wildlife Service to California Department of Fish and Wildlife and U.S. Bureau of Reclamation. Red Bluff, CA. 138pp.

Satterthwaite, W.H., M.P. Beakes, E.M. Collins, D.R. Swank, J.E. Merz, R.G. Titus, S.M. Sogard, and M. Mangel. 2010. State-dependent life history models in a changing (and regulated) environment: steelhead in the California Central Valley. Evolutionary Applications. 3:221–243.

Shapovalov, L. and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with special reference to

Waddell Creek, California, and recommendations regarding their management. California Department of Fish and Game, Fish Bulletin 98:1-375.

USEPA [U.S. Environmental Protection Agency]. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards. Region 10, Seattle, WA. EPA 910-B-03-002. 49pp. Available online at: <http://www.epa.gov/r10earth/temperature.htm>. Website accessed on June 23, 2004.

USFWS [United States Fish and Wildlife Service]. 2008. Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Fish and Wildlife Service, California and Nevada Region, Sacramento, California. December 15, 2008. 396 pp.

Vogel, D. A. and K. R. Marine. 1991. Guide to Upper Sacramento River Chinook salmon life history. Prepared for the U.S. Bureau of Reclamation, Central Valley Project. 55 pages.

WDOE [Washington State Department of Ecology]. 2002. Evaluating Standards for Protecting Aquatic Life in Washington's Surface Water Quality Standards: Temperature Criteria. Draft Discussion Paper and Literature Summary. Publication Number 00-10-070. 189pp.

Federal Register Notices Cited

Volume 55 pages 46515-46523. November 5, 1990. National Marine Fisheries Service. Final Rule: Endangered and Threatened Species; Sacramento River Winter-run Chinook Salmon.

Volume 58 pages 33212-33219. June 16, 1993. National Marine Fisheries Service. Final Rule: Designated Critical Habitat; Sacramento River Winter-Run Chinook Salmon.

Volume 59 pages 440-450. January 4, 1994. National Marine Fisheries Service. Final Rule: Endangered and Threatened Species; Status of Sacramento River Winter-run Chinook Salmon.

Volume 64 pages 50394-50415. September 16, 1999. National Marine Fisheries Service. Final Rule: Threatened Status for Two Chinook Salmon Evolutionarily Significant Units in California.

Volume 70 pages 37160-37204. June 28, 2005. National Marine Fisheries Service. Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs.

Volume 70 pages 52488-52627. September 2, 2005. Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California; Final Rule.

Volume 71 pages 834-862. January 5, 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead; Final Rule.

Volume 71 pages 17757-17766. April 7, 2006. Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon.