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Attorneys for **SAN JOAQUIN TRIBUTARIES AUTHORITY**

BEFORE THE CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

IN THE MATTER OF

CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLATION PETITION FOR WATER RIGHT CHANGE RE: CALIFORNIA WATERFIX.	**TESTIMONY OF DOUG DEMKO (San Joaquin Tributaries Authority [SJTA] SJTA REBUTTAL, EXHIBIT 402)**

I, Doug Demko, declare as follows:

SUMMARY OF CREDENTIALS

1. I am a fisheries professional and the President of FISHBIO Inc., a U.S. based company that specializes in fisheries research, monitoring, and conservation. I am the President of FISHBIO Laos, Limited, a foreign company that specializes in fisheries research, monitoring, and conservation in the Mekong River Basin in South East Asia. I am the President of La Cuesta Roja, S.A., a Costa Rican company established to develop a research center for the purpose of conducting fisheries research, monitoring, and conservation of freshwater and marine environments in Central America. I am the President of Roja Adventures, S.A., a Costa Rican company established for the purpose of promoting eco-tourism, education, and conservation practices in Costa Rica. I fund and lead the development of the Mekong Fish Network (mekongfishnetwork.org), an international effort to promote research data sharing and collaboration among diverse governments and interests in the Mekong River Basin. I also fund FISHBIO's Three Rivers program, an effort to promote fisheries

and environmental education for primary school children. Collectively, I employ, manage, and oversee roughly 50 people (depending on year, season, project requirements) domestically and internationally for the purposes of fisheries research, monitoring, conservation, and ecotourism.

2. I have testified as a fisheries expert witness before the U.S. House of Representatives. I have twice testified as a fisheries expert witness in front of the California State Legislature on Central Valley fisheries management issues. I also testified before the State Water Resources Control Board (SWRCB) a number of times relating to California Central Valley fisheries management issues.

3. I have 29 years of experience researching and monitoring fish populations in California's Central Valley. I have been involved with research and monitoring projects in the Stanislaus River in the San Joaquin basin since 1991, likely longer than any other Central Valley researcher. I led the development of unique sampling strategies in the Stanislaus River (and other tributaries), such as using upstream and downstream rotary screw traps to evaluate migration rate and in-river salmon mortality rates; use of a portable resistance board weir and underwater camera to evaluate upstream adult Chinook salmon abundance and factors, such as flow, that may influence their migration; conducting annual summer *O. mykiss* abundance surveys to evaluate population size, factors that influence the population, and factors that may influence anadromy or residency life history strategies.

4. Since 1991 I have led or been involved in numerous studies on the Stanislaus, Tuolumne, Merced, Mokelumne, and Calaveras rivers. A partial list of these efforts includes: establishing long term juvenile and adult salmon monitoring programs (rotary screw traps, seine, weirs, remote cameras, snorkel); Chinook salmon redd surveys to assess spawn timing and habitat preferences; radio tracking juvenile Chinook to evaluate migration rates and mortality; wire fyke trapping to evaluate non-native predator species abundance; boat electrofishing to evaluate fry habitat use; boat electrofishing to remove predators from Clifton Court Forebay; Vernalis Adaptive Monitoring Plan study to evaluate relationships between salmon smolt survival and San Joaquin River flows, exports, and operation of the Head of Old River Barrier; juvenile chinook and *O. mykiss* floodplain use; floodplain habitat assessments; habitat mapping; habitat restoration; hatchery

assessments; mark-recapture studies; development of a 5 year program to assess predator abundance and influence on juvenile Chinook salmon mortality in the Stanislaus River with NOAA Fisheries and CDFW; estimation of *O. mykiss* oversummering abundance; Habitat Conservation planning; benthic macroinvertebrate assessments; migration barrier assessments; Chinook salmon stranding surveys; Watershed Stewardship Group facilitation; and volunteer snorkel surveys.

5. Internationally my fisheries research and monitoring experience includes projects in the Mekong Basin, including projects in Laos PDR, Vietnam, Cambodia, and Thailand. A partial list of these projects includes: establishing fisheries monitoring programs including programs driven by large power companies and remote villages; establishing and studying Fish Conservation Zones; Mekong Giant Catfish satellite telemetry; use of environmental DNA to identify species distribution; establishing and training villagers in participatory fishery monitoring surveys; developing community water quality and water resource management programs; seasonal wetlands evaluation; state of the basin assessments; climate change and aquatic organisms assessment; fisheries management plans; fish hatchery assessment; establishment of turtle conservation zones; and macroinvertebrate assessments.

6. Since starting FISHBIO in 2006 I have worked for or partnered with many private companies, public agencies, Non-Government Organizations, non-profit groups, and universities for the purposes of researching fish populations domestically and internationally. A partial list of clients, partners, and grantors includes: U.S. State Department; World Wide Fund for Nature (WWF); Mohamed bin Zayed Species Conservation Fund; International Union for Conservation of Nature (IUCN), Laos, and Critical Ecosystem Partnership Fund (CEPF); The Asia Foundation; Sustainable Mekong Research Network (SUMERNET); International Crane Foundation; Fauna & Flora International, Myanmar; Theun Hinboun Power Company; Mekong River Commission; Nam Ngiep Power Company; The Agro Biodiversity Institute; University of Nevada Reno; USAID; Wildlife Conservation Society and Turtle Survival Alliance; Chiang Mai University and International Development Research Centre; Earth Systems Mekong; United States Bureau of Reclamation; California Department of Water Resources; San Joaquin Tributaries Authority; Modesto and Turlock Irrigation Districts; Merced Irrigation District; Oakdale Irrigation District;

South San Joaquin Irrigation District; West Stanislaus Irrigation District; Banta-Carbona Irrigation District; Patterson Irrigation District; Stockton East Water District; South Valley Water Association; River Partners; The Nature Conservancy; NOAA Fisheries; Monterey County Water Resource Agency; ICF International.

7. Attached as Exhibit 1 is a true and correct copy of my curriculum vitae.

OVERVIEW OF TESTIMONY

8. For this proceeding, my testimony will address deficiencies of the State Water Resources Control Board's (SWRCB) 2010 report entitled Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem that I will hereafter refer to as the Delta Flow Criteria Report (DFCR). The specific basis for my rebuttal testimony, and specific case-in-chief evidence to which it is responsive, is set forth in SJTA-Exhibit 404 (Declaration of Tim O'Laughlin).

9. The DFCR is being used to inform analysis for a change in the point of diversion of the State Water Project or the federal Central Valley Project from the southern Delta to a point on the Sacramento River as required by the Delta Reform Act. The DFCR claims that 60% of unimpaired flow (UIF) of the San Joaquin River during February- June is needed to transport fall-run Chinook salmon (FRCS) smolts through the Delta during spring to contribute to the SWRCB's 2006 Bay-Delta Plan salmon protection water quality objective (doubling goal). However, there are deficiencies in the DFCR analyses which, in addition to the limitations acknowledged by the SWRCB in the DFCR, further restrict its utility. My testimony will discuss shortcomings of the DFCR analysis, and reasons why substantial increases in San Joaquin River flows cannot be expected to contribute substantially to the SWRCB's 2006 Bay-Delta Plan salmon protection water quality objective. These issues are briefly summarized below, followed by more detailed discussion in the following sections.

- The DFCR uses a nine-component 60% UIF to estimate the frequency at which 5,000 cfs and 10,000 cfs would be met at Vernalis. However, the Phase I revisions to the Bay-Delta Plan only address three of these components: the Stanislaus, Tuolumne &

Merced Rivers. As a result, the DFCR grossly overstates the frequency at which these flows would occur.

- Purported threshold values cannot be met in most years under managed conditions, smolt survival to Chipps Island will not be substantially improved, and recovery of salmon populations, particularly as defined by the “doubling goal”, cannot be achieved through implementation of the flow regime proposed by the Petitioners in this proceeding for the San Joaquin River (i.e., Water Rights Decision 1641), nor by the flow regime proposed in the SWRCB’s Phase I Revisions to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Phase I Revisions to Bay-Delta Plan).

- The DFCR references results from Version 1.6 of CDFW’s SalSim model as presented in CDFW Exhibit 3 as the primary basis for the San Joaquin River flow recommendations. During the peer review process of the updated version (2.0) of SalSim, the panel noted that “much additional work is needed for SalSim to be management-ready” (p.11). Further, the panel was not confident that the existing model has sufficiently realistic representations regarding the effects of flow and temperature in the freshwater life stages (p. 8). Therefore, it cannot be considered the best available science and does not provide a sound, scientific basis for the San Joaquin flow recommendations made by the SWRCB in the DFCR.

- The use of CDFW Exhibit 3 is not consistent with the Central Valley Project Improvement Act (CVPIA) Section 3406(b)(1) which specifically calls for doubling of numerous anadromous species in the Central Valley. Production is defined as the number of Chinook salmon captured in ocean and recreational fisheries, in addition to the number that returned to the spawning grounds (i.e., escapement). The CVPIA Doubling Goal is not doubling smolt production nor is it doubling of adult production in the San Joaquin Basin or any given tributary.

- Even if modeling results are treated as reliable (i.e., if there was a positive [and consistent] relationship between increased flow and smolt survival), gains in survival to

Chipps Island would be insufficient to compensate for natural and fishing mortality at later life stages.

- Given the now significantly improved understanding of Chinook salmon populations in the San Joaquin River basin and, more broadly, in the Central Valley (pertaining to *hatchery operations, survival- and population dynamics*), physical characteristics of the basin *(hydrodynamics*, *water temperature coldwater pool management*, *floodplain habitat*), and existing constraints (*i.e., predation pressures, excessive ocean harvest rates, limited in-river and Delta habitat*), DFCR flows will not substantially improve Chinook salmon survival through the Delta. As a direct consequence, the viability, sustainability, production, and escapement of SJR Chinook populations will not be substantially improved over the current conditions by the Petitioners' proposal for flows on the San Joaquin River (i.e., D-1641), nor by the Phase I Revisions to the Bay-Delta Plan. The DCFR and related exhibits failed to account for the underlying population dynamics of the San Joaquin River population of fall-run Chinook salmon. This population is characterized by a pronounced cyclic nature with boom and bust cycles that occur approximately every 12 - 15 years with low periods of abundance corresponding to drier or drought periods. However, the DFCR cannot substantially improve conditions during these periods, which may limit long-term population abundance, and therefore has little chance of improving the overall viability, abundance, or productivity of this population.
- Implementation of the DFCR would result in frequent depletion of reservoir coldwater pools, leading to elevated in-stream water temperatures in late summer and fall. Fisheries monitoring during the recent drought demonstrated the deleterious effects of elevated temperatures on over-summering populations of threatened *O. mykiss* and fall-run Chinook salmon reproduction.

TESTIMONY

10. Under the Delta Reform Act of 2009, the SWRCB was required to develop new flow criteria for the Delta. The SWRCB's review of existing water quality objectives, analyses of existing data, and recommendations for the volume, quality, and timing of water needed for the

Delta were presented in the DFCR. As required by the Delta Reform Act, the DFCR is being used to inform analysis for a change in the point of diversion of the State Water Project or the federal Central Valley Project from the southern Delta to a point on the Sacramento River.

11. One of the biological goals of the DFCR was to provide sufficient flow in the San Joaquin River to transport smolts through the Delta during spring to contribute to the SWRCB's 2006 Bay-Delta Plan salmon protection water quality objective. As such, the DFCR considered flow alone as the factor responsible for depressed production of fall-run Chinook salmon, and, by extension, as the sole remedy to improve struggling salmon populations to achieve the doubling goal. The DFCR does not consider additional limiting factors such as harvest allotments, predation, or hatchery practices, nor does it discuss and accurately consider the limitations of physical or biological responses that could be achieved by increasing flows (flow thresholds cannot be met as frequently as portrayed; opportunity to inundate habitats with floodplain characteristics is extremely limited within the range of managed flows). Lastly, the DFCR omits evaluation of competing beneficial uses, particularly in light of the ambiguity, uncertainties, and shortcomings of portrayed benefits to salmonid populations.

12. The DFCR relies on Exhibits submitted by TBI, NRDC, CalSPA, and most notably by CDFW (Exhibit 3), hypothesizing that increased spring flows increases salmon smolt survival, and that subsequent adult abundance is substantially increased. I will discuss three major deficiencies in the use of these exhibits in the DFCR.

13. First, the DFCR concluded that (1) spring flows of 5,000 cfs represent a flow threshold to substantially improve juvenile salmon survival and subsequent adult abundance, and (2) average flows of 10,000 cfs during this period may provide conditions to achieve doubling of San Joaquin Basin FRCS based on analyses of water temperatures and population growth submitted by TBI/NRDC. However, the DFCR also noted on page 121 that "additional information should be developed to determine whether these flows could be lower or higher and still meet the Chinook salmon doubling goal in the long-term". In other words, there was an indication of these flows potentially representing threshold values, but the issue needed further investigation. At any rate, it

was estimated that 60% UIF would meet or exceed 5,000 cfs in more than 85% of years and would meet or exceed 10,000 cfs in approximately 45% of years.

14. However, as explained in the testimony of Daniel B. Steiner (SJTA Exhibit 401), the DFCR analysis used a nine-component UIF for the San Joaquin Valley as the foundation for its simulations. These include not only the unimpaired flow of the Stanislaus, Tuolumne, and Merced rivers (at reservoir), but also include the San Joaquin River at Friant, overflows from the Kings River, the Fresno and Chowchilla Rivers, and valley floor components. Limiting the requirement to only the Stanislaus, Tuolumne, and Merced rivers excludes approximately 40% of the watershed above Vernalis, resulting in much lower flows at Vernalis than the 60% UIF of the entire San Joaquin Basin as analyzed by the DFCR. Specifically, the frequency of meeting 5,000 cfs and 10,000 cfs under 60% UIF decreases from 85% to 60% and from 45% to 10%, respectively (compare Figure 1 with Figure 2; see Table 1). Under the 40% UIF proposed by Phase I of the WQCP, 5,000 cfs is reached 41% of the time, but 10,000 cfs is never met (Figure 3; Table 1). For comparison, actual historical flows during 1986-2003 reached 5,000 cfs 35% of the time and reached 10,000 cfs approximately 25% of the time, which is more often than the 10% under a 60% UIF (Figure 2; Table 1). As a consequence, the population growth inferred in the DFCR cannot be expected to occur.

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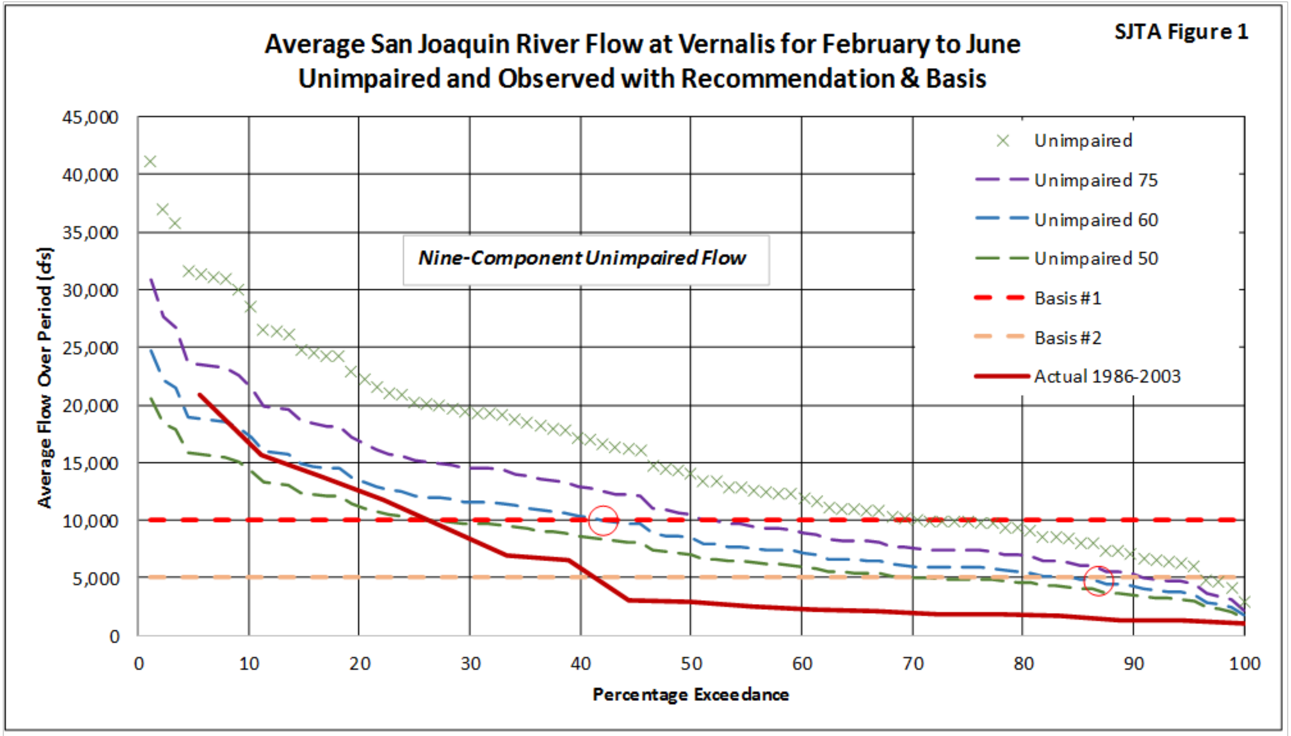

Figure 1. Frequency of occurrence of average February-June San Joaquin River flow at Vernalis. (Nine-Component Unimpaired Flow)

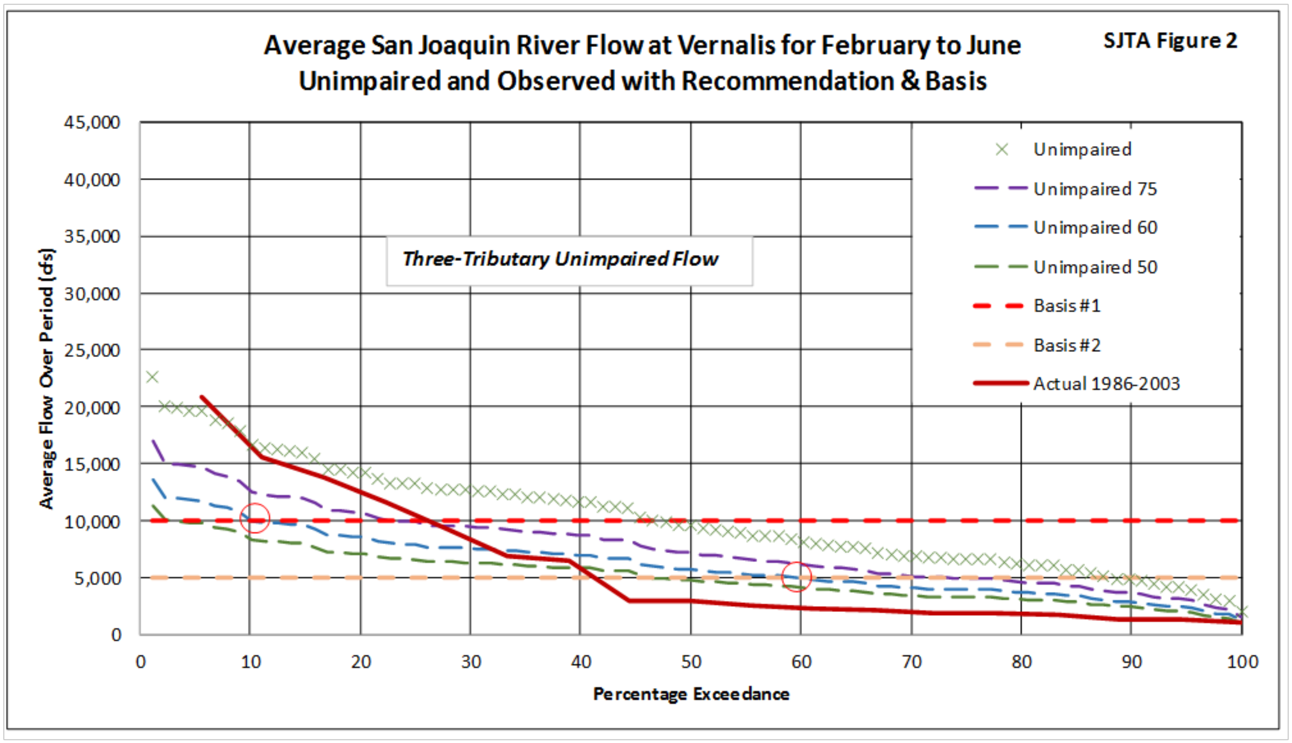

Figure 2. Frequency of occurrence of average February-June San Joaquin River flow at Vernalis. (Three-Tributary 60% Unimpaired Flow)

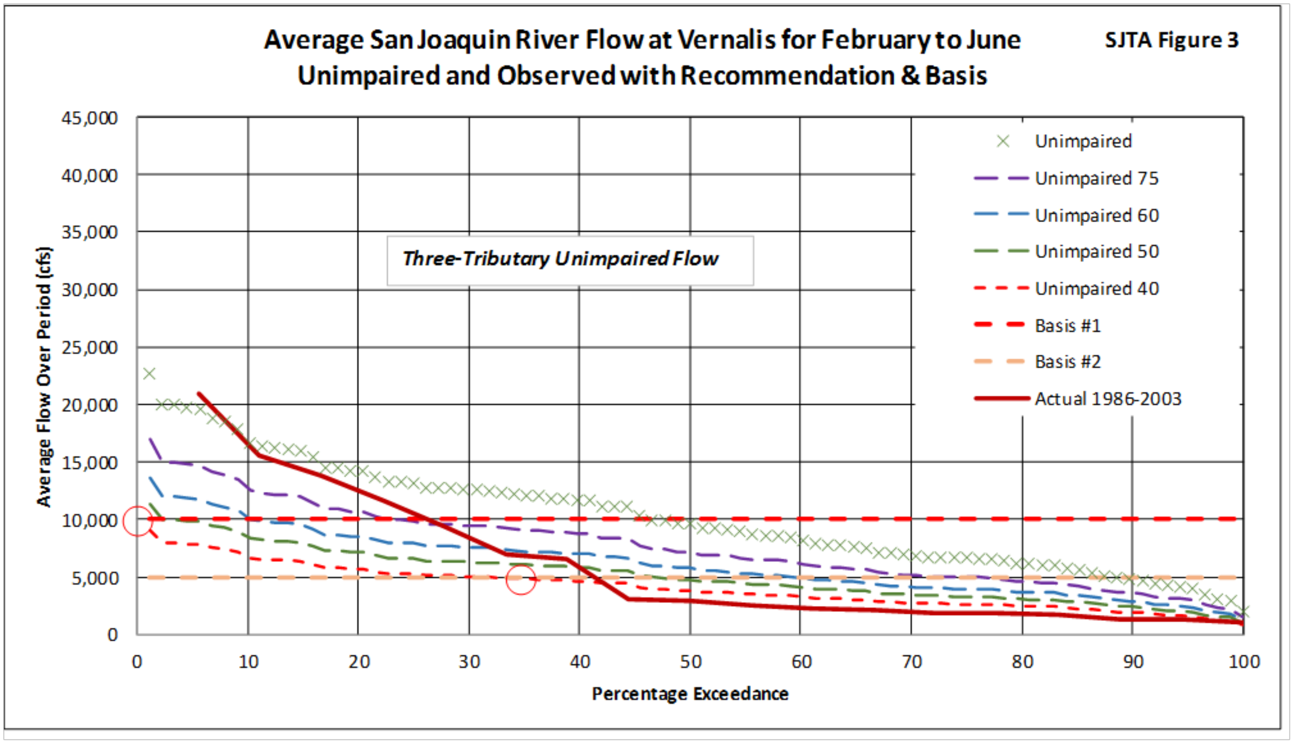

Figure 3. Frequency of occurrence of average February-June San Joaquin River flow at Vernalis. (Three-Tributary 40% Unimpaired Flow)

Table 1. Summarized frequency of occurrence of 5,000 cfs and 10,000 cfs at Vernalis at 60% UIF of the entire San Joaquin Basin (DFCR); 60% UIF of the Stanislaus, Tuolumne, and Merced rivers; 40% UIF of the Stanislaus, Tuolumne, and Merced rivers (Phase I WQCP) and under actual, historical conditions.

	Frequency	
Scenario	**5,000 cfs**	**10,000 cfs**
DFCR 60% UIF	85%	45%
Tributary only 60% UIF	60%	10%
Tributary only 40% UIF (Phase I WQCP)	35%	0%
Actual	41%	25%

15. A second major deficiency is that the use of CDFW Exhibit 3 is not consistent with the Central Valley Project Improvement Act (CVPIA), which specifically called for the doubling of numerous anadromous species (various runs of Chinook salmon, steelhead, American shad, white sturgeon, and striped bass) in the Central Valley (CVPIA Section 3406(b)(1)). Production was

defined as the number of Chinook salmon captured in ocean and recreational fisheries, in addition to the number that returned to the spawning grounds (i.e., escapement). Chinook salmon susceptible to the ocean fishery primarily consist of age-2, age-3, and age-4 fish. However, this contradicts the text in CDFW Exhibit 3 (pages 34 and 35), Table 10, and Figure 20, which specifically states that: "... improving stream flow in the spring time period in the SJR east-side tributaries, resulting in increased SJR flows at Vernalis, is necessary to accomplish the State and Federal doubling goal by doubling juvenile (smolt) abundance at Chipps Island." To be clear, doubling smolt production is not the legal requirement specified in the CVPIA Doubling Goal, nor is doubling adult production in the San Joaquin Basin or any given tributary.

16. Even if 200,000 salmon smolts were produced at Chipps Island, it would not result in increased salmon abundance to meet the goal of doubling adult production. For example, in 1993, the modeled smolt production under the revised flows estimated that there would be 200,000 additional smolts at Chipps Island over the historical number (Figure 20 of CDFG Exhibit 3 or DFCR). To meet the doubling goal from 1992 to 2011 in any given year, roughly 750,000 fall-run Chinook salmon naturally produced in Central Valley streams would have to be harvested or return to spawn. Therefore, even if all (100%) of the 200,000 additional smolts at Chipps Island survived to be harvested or returned to spawn, this increase would still be insufficient to meet the true intent of the doubling goal. It follows that the DFCR has no basis to claim that increasing flow on the San Joaquin River will double the natural production of Central Valley fall-run Chinook salmon.

17. It may seem reasonable to assume that increased abundance at Chipps Island would - generally - result in increased adult abundance several years later. However, to suggest that increased, or "maximized" flows during the spring months serve to increase "production" to Chipps Island is unsubstantiated. I interpret "production" of smolts in the document to mean "survival to". Recent scientific investigations have confirmed that high river flow cannot guarantee high survival, as survival has been demonstrated to be low, even in wet years (e.g. 2011[1]).

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[1] Buchanan et al. 2018

18. A third major deficiency of the DFCR is that it references results from Version 1.6 of CDFW's SalSim model as presented in CDFW Exhibit 3 as the primary basis for the San Joaquin River flow recommendations. Peer-review of a more recent verson of the SalSim model (Version 2.0) in 2012, found that "much additional work is needed for SalSim to be management-ready"[2, p.11]. The panel detailed their concerns and provided several recommendations for improvements: "The panel was not confident that the existing model has sufficiently realistic representations regarding the effects of flow and temperature in the freshwater life stages. Better documentation and examination of diagnostics would alleviate some concerns, but several issues go beyond that. These include the focus on the San Joaquin data only; over-emphasis on flow in relationships and lack of inclusion of other covariates; and only limited results of calibration, sensitivity, and retrospective analyses being reported to date" [2, p. 8]. The modeling results therefore do not represent best available science and provide no sound basis for the San Joaquin flow recommendations made by the SWRCB in the DFCR.

19. Version 2 of the SalSim model[3] was used in Chapter 19 of the SWRCB's Substitute Environmental Document (SED) for the Phase I Revisions to the Bay-Delta Plan, and presumably addressed some of the problems identified with Version 1 of the model. Simulated increases in adult FRCS production on the Stanislaus, Tuolumne and Merced Rivers over the base scenario were low (9.7% in the 40% UIF, 7.6% in the 50% UIF, and 6.5% in the 60% UIF scenarios; see Table 19-32). Furthermore, these increases are, in all cases, below 10%, which the SWRCB considers "a significant benefit or impact" in other modelling scenarios (i.e. pertaining to temperature targets, Chapter 19 p. 19-18, or floodplain inundation, p 19-56). According to the SalSim results in the SWRCB's more recent WQCP/SED analysis, the flows recommended in the DFCR would not provide significantly improved salmon production.

20. Disregarding these flaws in the DFCR analysis, the question remains whether substantial increases in flow contribute substantially to doubling natural production of Central Valley fall-run Chinook salmon. The answer, unfortunately, is no. Recent scientific investigations

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[2] Anderson et al. 2012

[3] AD Consultants 2014

suggest that mortality factors in the San Joaquin Delta cannot be alleviated by increasing flows. Similarly, recent attempts to boost Central valley steelhead and fall-run Chinook salmon on the Stanislaus River through increased flows under the Biological Opinion have not resulted in increased natural production. Worse, the actions resulted in unintended, but foreseeable impacts to the very species that the actions were intended to protect.

21. These findings have become available since the DFCR was released in 2010, and are in direct conflict with the San Joaquin River flow recommendation of the DFCR. In the following sections of my testimony I will discuss why the San Joaquin River flows recommended by the DFCR are unsupported and will not achieve the doubling goal based on (1) the impacts of 60% UIF flows on conditions on the San Joaquin tributaries using the Stanislaus as an example, (2) the findings of survival studies conducted in the San Joaquin Delta relative to flow and other factors, (3) the influence of ocean conditions, (4) the continued, unsustainable, ocean harvest rates which thwart population growth, and (5) hatchery production which masks declines in natural production and continues to erode genetic integrity of Central Valley fall-run Chinook salmon.

1. Increased reservoir releases deplete coldwater storage needed to maintain suitable water temperatures

22. The DFCR failed to consider impacts of the proposed plan on coldwater pool maintenance in upstream reservoirs, which may jeopardize populations of salmonids, including threatened *Oncorhynchus mykiss*, that rely on the cool water temperature maintained by reservoir releases. The DFCR spends a page and a half (pp. 57-59) discussing water temperature. While the DFCR acknowledges “reservoir releases” as an important component, and states that “Temperature and water supply modeling and analyses should be conducted to identify conflicting requirements to achieve both flow and coldwater temperature goals”, no analyses have been performed to evaluate this component.”

23. The consequence of such management action is severely depleted reservoir storage at New Melones as shown in Mr. Steiner’s analysis if 60% unimpaired flow is required. This results in a severe reduction, or elimination, of the reservoir’s coldwater pool. Based on my experience monitoring fish populations in the Stanislaus River, we can expect two consequences: (1) water

temperatures downstream of Goodwin Dam will increase substantially, and (2) warm water temperatures will have detrimental impacts to ESA-listed CV steelhead and FRCS.

24. Storage in New Melones Reservoir under the DFCR's 60% UIF scenario would frequently drop to dead pool of 80 TAF (Figure 4; see also SJTA-401, Figure 7), and deleterious impacts to salmon and steelhead result as coldwater storage is depleted long before reaching dead pool. Records from water temperature monitoring during the recent drought illustrate that as reservoir storage decreases, water temperatures at Goodwin Dam increase (Figure 5). The modeled scenario shows that mean storage under the 60% UIF scenario would be below the record low storage observed in 2015 - corresponding to river temperatures approaching 70°F (21.1°C).

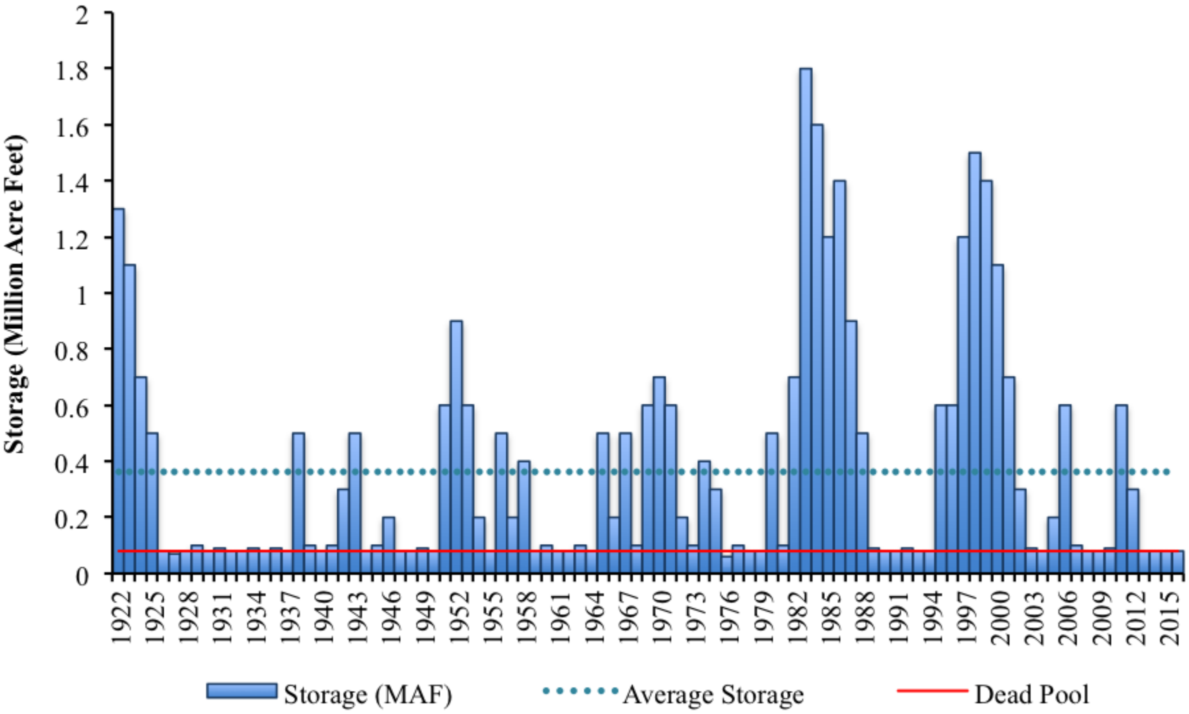

Figure 4. Simulated storage in New Melones Reservoir in late September, under the DFCR 60% UIF scenario.

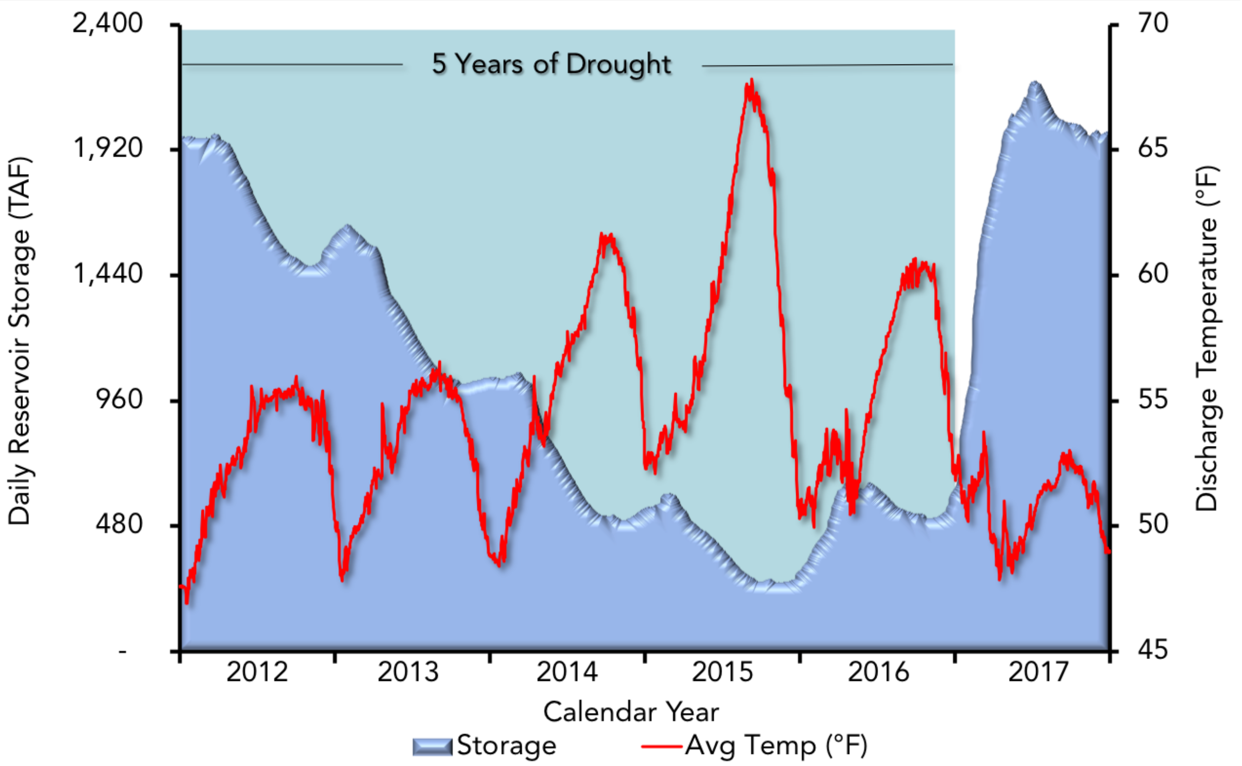

Figure 5. Relationship between average daily storage at New Melones Reservoir and mean daily water temperature below Goodwin Dam. (Source: FISHBIO hourly recording thermograph and CDEC reservoir storage for station NML)

25. Anadromous *O. mykiss* (steelhead), a threatened species under the ESA, remain in freshwater for at least one, but usually two summers before migrating to the marine environment. However, some *O. mykiss* do not migrate, but remain in the river as residents. As a consequence, snorkel surveys during the summer months can provide population estimates that are inclusive of all size/age classes and life history variants: juveniles that may migrate to sea, and adults that have adopted the resident life history. FISHBIO has conducted annual snorkel surveys in the Stanislaus River since 2009 to estimate the abundance and distribution of over-summering *O. mykiss*, and to document population responses to flow, water temperature, and habitat[4].

26. The population of *O. mykiss* in the Stanislaus River is composed almost entirely of resident fish, with few migrating individuals, and until recently, the population was fairly large and stable. The majority of *O. mykiss* are found upstream of Orange Blossom Bridge with the highest

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[4] Peterson et al. 2015

densities found between Goodwin Dam and Knights Ferry (Figure 6). Elevated water temperatures (above the typical summer temperature of approximately 55°F (12.8°C); monthly mean temperature at Goodwin), beginning in 2014, coincide with the decline in *O. mykiss* densities across all reaches. The warmest water temperatures of approximately 67°F (19.4°C) were recorded during the summer of 2015.

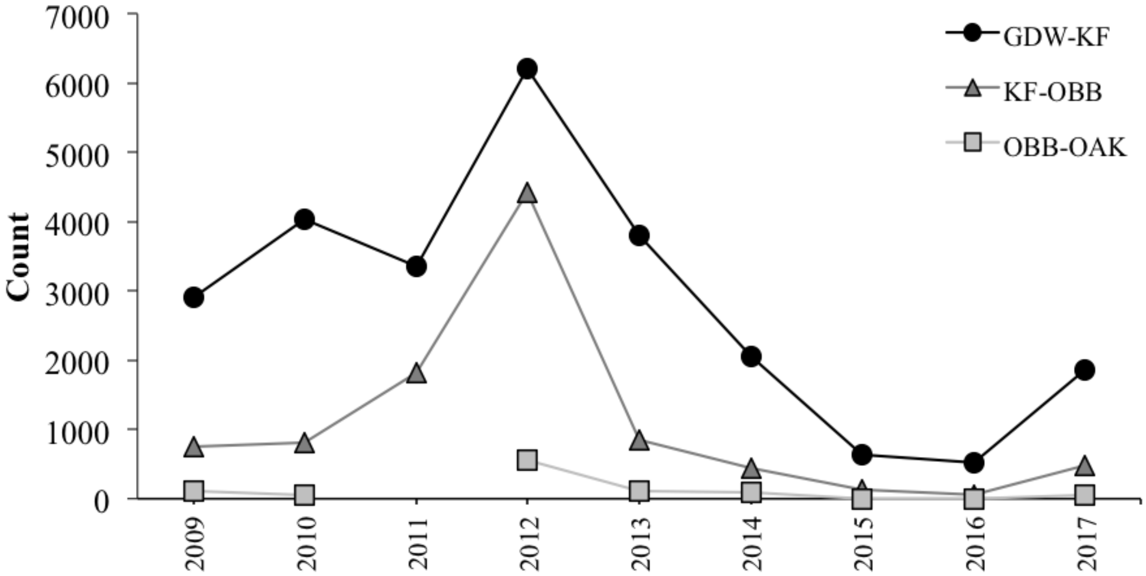

Figure 6. Fish per river mile (density) estimates made during fall snorkel surveys, 2009-2017 in the Stanislaus River. All reaches were sampled all years except for OBB to OAK in 2011. Reach names are Goodwin Dam to Knight's Ferry (GDW-KF), Knight's Ferry to Orange Blossom Bridge (KF-OBB), and Orange Blossom Bridge to Oakdale (OBB-OAK)(FISHBIO; unpublished data).

27. From 2009 until 2014, overall abundance averaged about 20,000 individuals, peaking in 2012 when a large number of young/small fish were observed following flood control releases and unusually cool summer water temperatures the previous year. Following this peak, overall abundance of *O. mykiss* declined sharply during drought, falling to a low of approximately 5,000 in 2015 and 2016. The population began to recover in 2017 (Figure 7).

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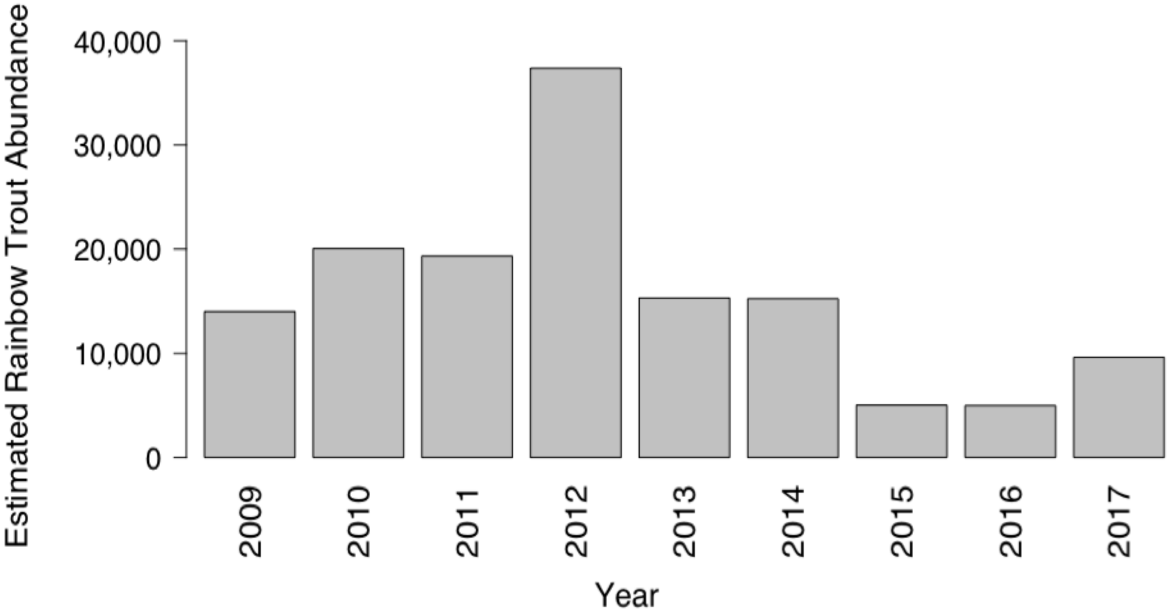

Figure 7. Annual *O. mykiss* abundance in the Stanislaus River during 2009-2017 (FISHBIO; unpublished data).

28. Estimated *O. mykiss* abundance during 2009-2017 tracks very closely with water temperatures, and lower *O. mykiss* abundance was observed in years following warmer summer temperatures (Figure 8). It follows that carry-over storage and maintenance of an adequate cold-water pool to provide summertime releases of sufficiently cool water are integral to maintaining suitable habitat for *O. mykiss* in the Stanislaus River, as well as below other reservoirs.

29. Trends in densities and abundance clearly indicate that these population indices of *O. mykiss* can be adversely impacted by elevated stream temperatures which, in turn, are a consequence of depleted storage in New Melones Reservoir during the recent drought. Under the current operational requirements and constraints, the cold-water pool in New Melones Reservoir was depleted during the recent drought, which inhibited the ability to provide cold-water releases during the summer months of this period, and resulted in a drastic decline in abundance of *O. mykiss*. Depletion of storage is expected to occur at a faster rate and more frequently under the flow regime proposed by the DFCR.

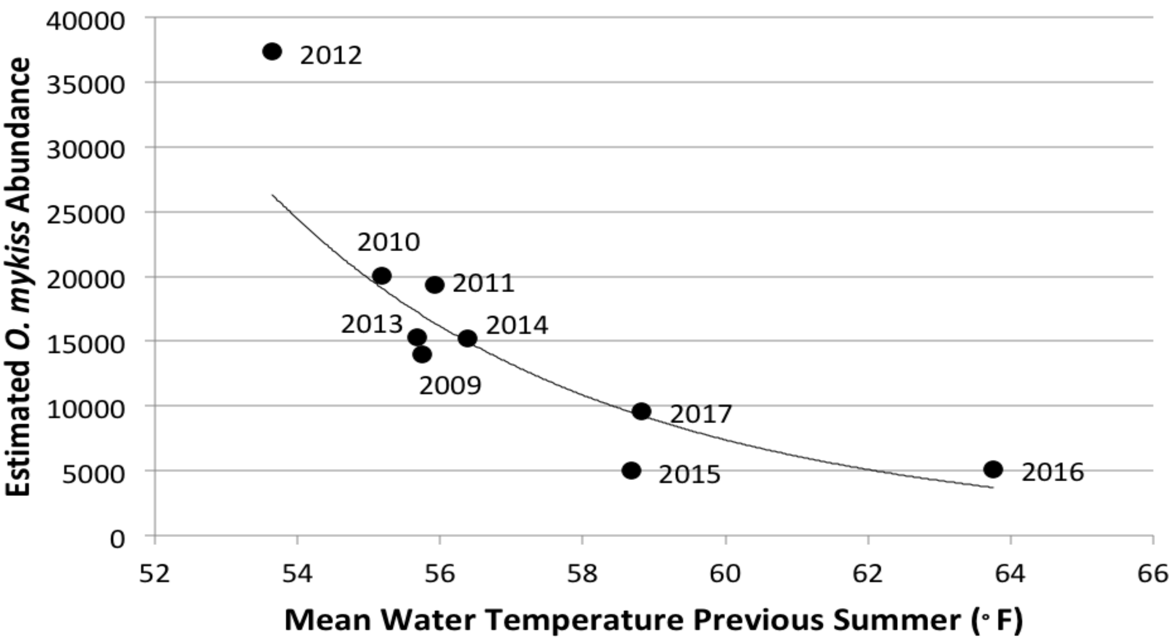

Figure 8. Abundance of *O. mykiss* in the Stanislaus River relative to the mean summer water temperature the previous year (June – August at Goodwin Dam)[5,6].

30. Adult fall-run Chinook salmon that enter the Stanislaus River to spawn in fall can also be impacted by warm water temperatures when coldwater storage in the reservoir is depleted. The timing of their upstream migration and spawning has been monitored since 2003 and 2009, respectively, using a portable, resistance board weir and redd surveys. Monitoring data spanned the most recent drought, which included the years when the coldwater pool of New Melones was depleted (described above).

31. It is believed reproductive timing of Chinook salmon (and many other fishes) is largely under genetic control and relatively fixed, an adaptation to long-term average temperature regimes that control and optimize the time of fry emergence[7]. In order for adult Chinook salmon to migrate to their spawning grounds, begin and complete spawning under less than optimal environmental conditions, adult Chinook salmon can adjust their migration rates and exhibit

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[5] Peterson et al. 2015

[6] FISHBIO unpublished data

[7] Quinn 2005

behavioral thermoregulation if water temperatures exceed certain thresholds[8,9]. It is especially important for them to conserve enough energy to complete the spawning process. Chinook salmon may begin spawning when water temperatures near 60.8°F (16°C), the upper temperature limit for 50% mortality.[10] After arriving on the spawning grounds, female Chinook salmon tend to spawn without much delay, which may serve to maximize the time guarding the red.[11]

32. From 2009 to 2013, daily water temperatures from Goodwin Dam summarized from October 1 to December 31 remained relatively consistent throughout the fall spawning season (mean range 53.2°F - 54.1°F [11.8 – 12.3°C]). However, in 2014 and 2015, the average temperatures were substantially higher during the fall (means = 57.7°F [14.3°C] and 64.0°F [17.8°C], respectively). The timing of redd deposition was estimated from data collected during annual redd surveys. Based on the timing of redd deposition and the patterns of water temperature, during 2009 to 2013, almost all spawning was estimated to have occurred in 7DADM water temperatures that were below or very close to the EPA[12] criteria for spawning Chinook salmon (55.4°F [13ºC]; Figure 9). In these years, daily average water temperatures typically decreased to 55.4°F [13ºC] by early to mid-October. Due to the depletion of the coldwater pool during the drought in 2014 and 2015, water temperatures often remained above 55.4°F [13ºC] until December in both years, which resulted in more than 95% of spawning to occur at water temperatures above 13ºC. These observations suggest that the ability for adult Chinook salmon to adjust or delay spawn timing is relatively limited relative to the ability to delay their migration rates. Notably, water temperatures in 2014 and 2015 did not approach or exceed the upper thermal tolerances for adult Chinook salmon[13] and no significant pre-spawn mortality was observed during these years.

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[8] Goniea et al. 2006
[9] Strange 2012
[10] Alderdice and Velsen 1978
[11] Quinn 2005
[12] EPA 2003
[13] Eaton and Scheller 1996

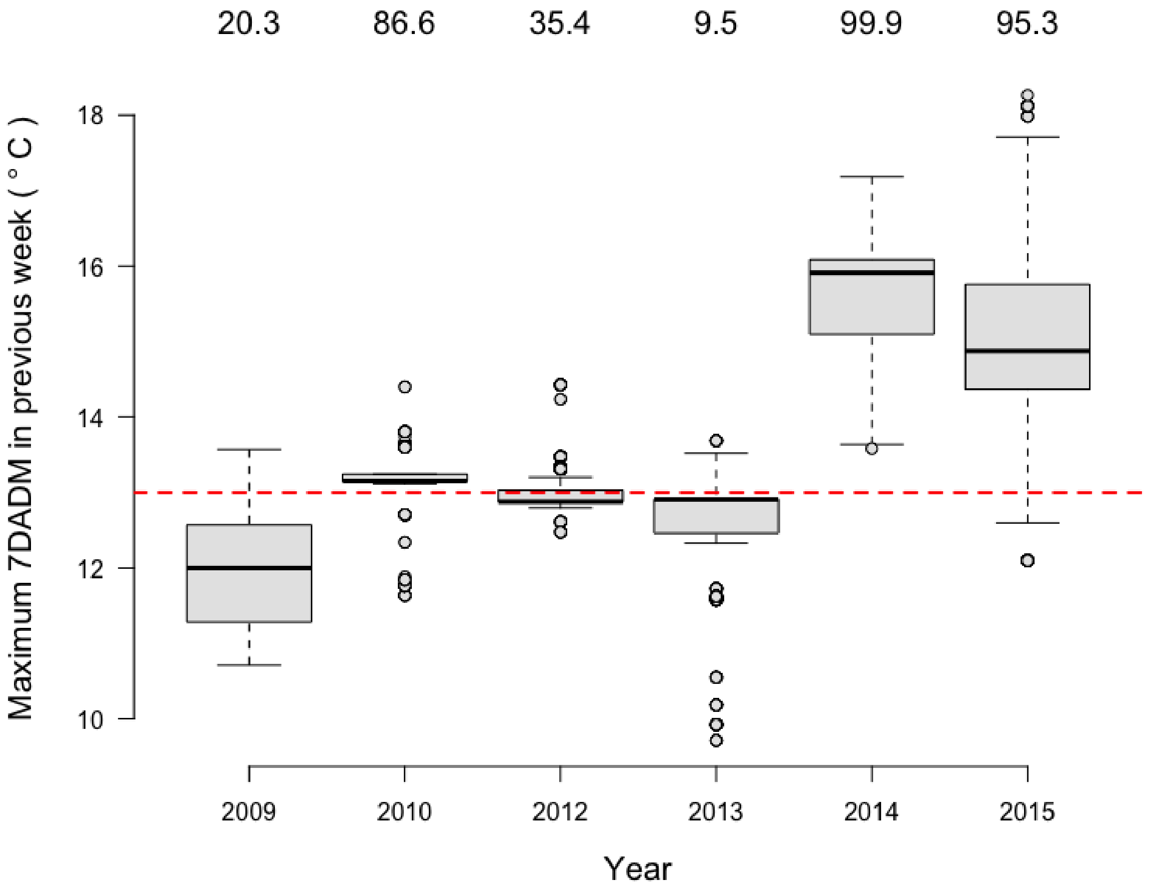

Figure 9. Distribution of Chinook salmon spawning activity (redd construction) in relation to water temperatures (7DADM; measured at Goodwin Dam [RM 58.4]) in the Stanislaus River. Horizontal red line represents 13°C [55.4°F], the recommended temperature guidance for spawning for trout and salmon (EPA 2003). Numbers across top are the estimated percentage of redds that were constructed at water temperatures greater than 13°C[14].

33. While mortality of offspring (eggs or alevin) related to high water temperatures was not the focus of redd monitoring, there appeared to be a significant decline in the numbers of juvenile Chinook salmon produced (estimated by rotary screw trap monitoring at Oakdale) per female spawner counted at the weir in these years. The estimated numbers of juveniles per female spawner in 2014 and 2015 were 109 and 84, respectively, which was well below the average number of recruits per spawners (551 [range 84 – 1,155][16]). Further, juvenile outmigrants in 2014 and 2015 were the progeny of approximately 5,400 adult spawners in each year (fall 2013 and 2014), yet juvenile abundance in 2015 was only 30% of the estimated juvenile abundance during

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[14] FISHBIO unpublished data

2014. Notably, water temperatures were far more favorable for incubation during fall 2013, and low reservoir storage during fall 2014 resulted in high water temperatures during spawning and incubation leading to a 70% reduction in juvenile production. These observations suggest that the focus on improving survival in one life stage (the smolt stage by increasing flows) is likely to have negative impacts on other life stages. It also shows that the full impact of the DFCR has not been adequately assessed.

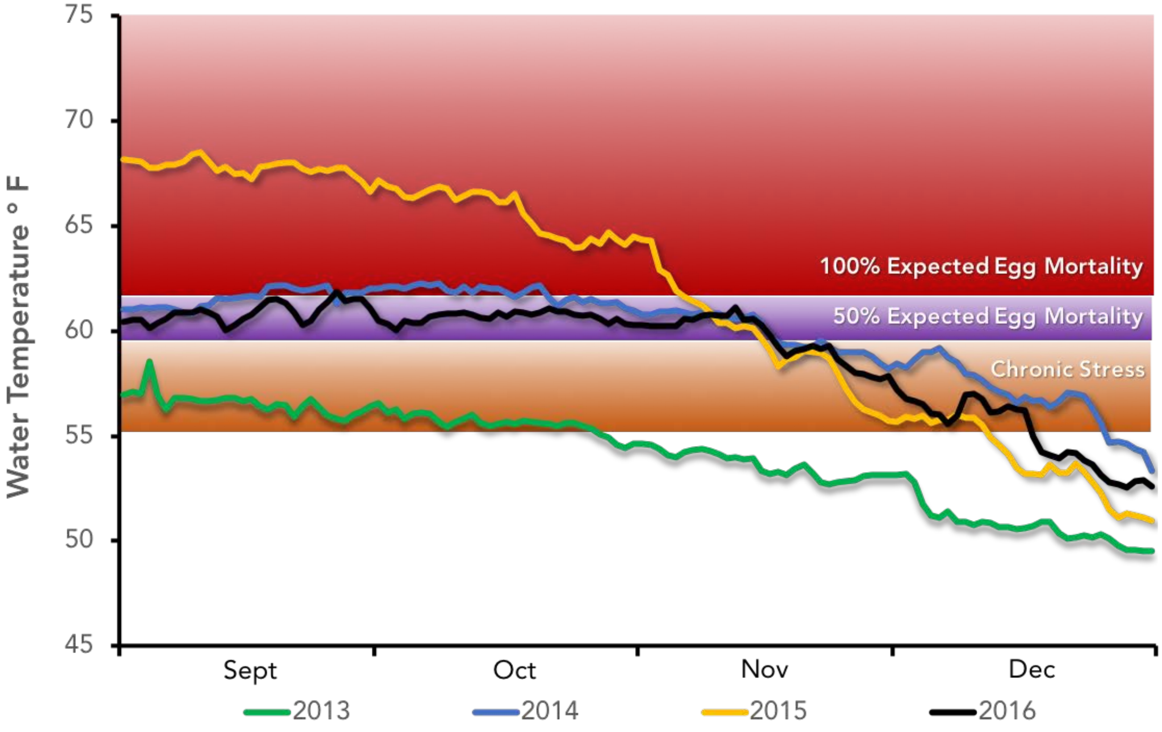

Figure 10. Stanislaus River water temperature below Goodwin Dam (RM 58.4) during fall spawning period 2013-2016 (note: 55.4ºF is equivalent to 13ºC; 60.0ºF is equivalent to 15.6 ºC, and 62ºF is equivalent to 16.7ºC)[15].

2. Increased San Joaquin River flows do not necessarily enhance juvenile salmon survival through the Delta

34. The Vernalis Adaptive Management Plan (VAMP) investigated the relationship between Chinook salmon smolt survival through the San Joaquin Delta and flow, exports, and

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[15] FISHBIO unpublished data

operation of the Head of Old River Barrier between 2000 and 2011. In the 2010 independent panel review of the Vernalis Adaptive Management Program, the panel repeatedly pointed out two important conclusions relevant to the Delta Flow Criteria Report.[16] First, the panel pointed out early on in their review that the reliance on flow alone would not consistently meet survival rates of juvenile Chinook salmon in the San Joaquin River and Delta. The rationale for this conclusion was that, particularly in recent years, survival rates at all flow levels was low. Since 2003, survival through the San Joaquin Delta has consistently been < 12%, while flows at Vernalis ranged between 2,000 cfs and 27,000 cfs. This is a similar finding to that of Buchanan et al. (2018). Both this conclusion of the review panel and the findings of Buchanan et al. (2018) present clear information that the proposed flow regime will not reliably improve juvenile Chinook survival. This was succinctly stated in the peer review panel's report: "These recent data serve as an important indicator that high Vernalis flow, by itself, cannot guarantee strong downstream migrant survival"[18, p. 3].

35. Second, the panel concluded that: "high and likely highly variable impacts of predation appear to affect survival rates more than the river flow." Further, the panel noted that the apparent high rates of predation observed during the latter portion of VAMP studies (i.e., when acoustic telemetry was used) may be "a very substantial cause of downstream migrant mortality[18, p. 10.]" As noted elsewhere, the lack of inclusion of factors other than flow (i.e., predation, ocean harvest rates, ocean conditions) in the development of the DFCR will severely limit any improvements to juvenile Chinook salmon survival from DFCR flows.

36. The DFCR (p. 59) states:

> "In analyzing the relationship between Vernalis flow and cohort return ratios of San Joaquin River Chinook salmon, TBI/NRDC found that Vernalis average March through June flows of approximately 4,600 cfs corresponded to an equal probability for positive population growth or negative population growth. (TBI/NRDC 3, p. 24.) TBI/NRDC found that average March through June flows exceeding 5,000 cfs resulted in positive population growth in 84% of years with only 66% growth in years with flows less than 5,000 cfs. (*Id.)* TBI/NRDC found that flows of 6,000 cfs produced a similar response as the 5,000 cfs flows and flows of 4,000 cfs or lower resulted in significantly reduced population growth of only 37%

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[16] Dauble et al. 2010

> of years. (*Id*.) The TBI/NRDC analysis suggests that 5,000 cfs may represent an important minimum flow threshold for salmon survival on the San Joaquin River. (*Id*.) Based on abundance to prior flow relationships, TBI/NRDC estimates that average March through June inflows of 10,000 cfs are likely to achieve the salmon doubling goal. (TBI/NRDC 3, p. 16-17.)"

37. As a recent publication asserts, increased flows are not necessarily associated with increased survival.[17] Moreover, factors beyond the freshwater and estuarine habitat have been shown to exert substantial influence over salmon populations, not only in California, and not only for Chinook salmon. Locally, the most prominent and telling example is the 2007/2008 collapse of the Central Valley salmon population, attributed to unfavorable ocean conditions[18] (discussed in more detail below).

38. The DFCR flow regime, assuming the model predictions are realistic, only results in appreciable increases in smolt production to Chipps Island in 3 of the 16 years (1993, 1996, 1997). Even if such increases could be achieved, the survival of these fishes to adulthood and a subsequent population increase is doubtful without addressing other limiting factors, primarily predation. Predation by non-native species is finally being recognized as a severe stressor to the conservation and recovery of native salmonids - and likely other species. The NMFS Draft Recovery Plan (2009) for Chinook salmon and Central Valley steelhead considers predation one of the most important stressors to the survival of juveniles. Although resource agencies have taken steps to circumvent the extreme predation problem, namely by shifting the release location of hatchery-produced fish from the tributaries to locations around San Francisco Bay (to avoid "conditions in the Sacramento River and Delta detrimental to the survival of juvenile salmon"[19]), little has been done to address - rather than avoid - the problem of predation.

39. Recent research[20] provides further evidence suggesting that predation, particularly in the lower reaches of the Delta, affects a large proportion of juvenile Chinook salmon, even in years when flows are high (2011). During their study, upwards of 20% to 64% of study fish (depending

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[17] Buchanan et al. 2018

[18] Lindley et al. 2009

[19] USFWS 2014

[20] Buchanan et al. 2018

on the year) were likely consumed by predators. Considering that these predation estimates apply to the area between Mossdale and Chipps Island only and do not include predation in the San Joaquin River or its tributaries, total predation losses of juvenile Chinook salmon originating from the Merced, Tuolumne and Stanislaus rivers are even higher.

3. Unfavorable ocean conditions can severely limit marine survival of Chinook salmon

40. The majority of Chinook salmon originating from Central Valley rivers and hatcheries enter the marine environment as sub-yearlings (they do not over-summer in freshwater environments). A relatively minor fraction of all Chinook salmon, particularly those belonging to the stocks of conservation concern (spring- and winter-run Chinook) remain in freshwater for at least one summer, and enter the marine environment the following year (as “yearlings”). In general,

41. Central Valley Chinook salmon remain at sea for 1 to 3 years, where they achieve more than 98% of growth (by weight) before returning to freshwater rivers to spawn.[21]

42. During that time, salmon must find sufficient food to survive and grow, escape predation, and avoid being captured in the fishery before reaching maturity. As expected, “the great majority of salmonids that migrate to sea do not return”.[23] It has long been recognized that Pacific salmon, in general, experience long-term abundance trends associated with ocean-climate regimes.[22,23,24] Other research has identified the biological predictors of diatom and zooplankton abundance and oceanic current conditions as important predictors of survival and growth during the early ocean phase of Chinook salmon[25].

43. Until reaching maturity, Chinook salmon originating from the Central Valley largely remain in the nearshore coastal waters of California, and do not travel long distances like northern populations.[26] As a consequence, localized conditions such as wind stress and upwelling strongly

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[21] Quinn 2005
[22] Mantua et al. 1997
[23] Beamish et al. 1997
[24] Hare et al. 1999
[25] Sabal et al. 2016
[26] Weitkamp 2010

influence marine growth and survival of Chinook salmon.[27] As noted, a vivid demonstration of the importance of ocean conditions on Chinook salmon survival was observed in 2007 and 2008 in the Central Valley, when an unprecedented collapse in the salmon stock precipitated a statewide closure of the ocean salmon fishery.[28]

44. In the years prior, abnormal patterns of the California Current, higher sea-surface temperature and weak upwelling (both considered detrimental to Chinook salmon[29]) were implicated in various biological responses, ranging from emaciated whales and abandoned nests of seabirds to unusual foraging patterns by sea lions. As expected, the unusual ocean conditions also affected juvenile salmon entering or rearing in the ocean during this time. The affected salmon brood years (2004 and 2005, respectively) entered the marine environment at abundance levels that correspond well to the long-term averages (based on data from 1970 – 2007[30]), yet far fewer fish reached maturity and returned to freshwater spawn. Ocean mortality was identified to be the proximate cause of the collapse[30]. High mortality was attributed to a lack of food resources for juvenile salmon, as the typical seasonal food web did not develop. This assertion was directly supported by the poor conditions of salmon sampled in the Gulf of the Farallones. While the 2007/2008 escapement years were an anomaly, this example serves to demonstrate – once more – that marine conditions can have profound effects of salmon survival, and factors beyond the control of resource managers can ultimately determine the abundance of Chinook salmon.

45. In order to safeguard against drastic fluctuations in population abundance resulting from unfavorable marine conditions, which are beyond the control of resource managers, steps should be taken to enhance the outmigration diversity of Central Valley Chinook salmon. As the Central Valley (fall-run) stock relies heavily on hatchery production, a release strategy that is more diversified and coordinated among hatcheries may be the most feasible near-term action that can serve to increase the resilience of the stock. Arguably, ocean survival may be somewhat lower in

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[27] Wells et al. 2008
[28] Lindley et al. 2009
[29] Petrosky and Schaller 2010

some years as a consequence, yet year-to-year or generation-to-generation abundance fluctuations are expected to be muted as a result.[30]

4. Unsustainable ocean harvest rates thwart population growth

46. Available information demonstrates that any effort by the SWRCB to double the natural production of CVFRCS in the San Joaquin River Basin will be ineffective due to the commercial fishery management protocols affecting the number of CVFRCS that are harvested in the ocean. Even if smolt survival to Vernalis or Chipps Island is improved under the DFCR proposal, the doubling goal can never be achieved because ocean harvest allotments prevent the necessary cohort-replacement rate.

47. At the SWRCB's June 6, 2011 scoping workshop for the review of the Bay-Delta Plan, the National Marine Fisheries Service gave a presentation which, among other things, identified the fishery conservation and management considerations under the federal Magnuson-Stevens Act, 16 U.S.C. §§ 1801 et seq. (MSA), as part of the regulatory framework affecting salmonids in the San Joaquin River Basin (see NMFS' June 6, 2011 presentation, slide #2, found at http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/060611wrkshp/nmfs.pdf). Due to the obvious link between the ocean harvest protocols developed under the MSA and the health and well-being of salmon populations in the San Joaquin River Basin, the San Joaquin River Group Authority (SJRGA) sued NMFS, the National Oceanic and Atmospheric Administration, the United States Department of Commerce, and the Pacific Fishery Management Council (PFMC) (collectively "the United States") regarding NMFS' adoption of the 2011 harvest of Sacramento River fall-run Chinook salmon (SRFC). Given the dire condition of CVFRCS as expressed by NMFS, USFWS, the DFG, and the non-governmental organizations, and as evidenced by the population crash in 2007 resulting in the closure of the ocean fishery in 2008 and 2009, the SJRGA was greatly concerned about the impact that overfishing was having on CVFRCS. The SJRGA concluded that because Sacramento River fall-run Chinook salmon, which are classified by NMFS as a "species of concern" (and more

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[30] Lindley et al. 2009

recently "reclassified" as a candidate species for listing as threatened or endangered) under the Endangered Species Act, 16 U.S.C. §§ 1531 et seq. ("ESA") are in peril, preventing the loss of 50-65 percent of the SRFC adult population due to ocean harvest would be both wise and in concert with the State's goal of doubling the production of salmon.

48. Irrespective of the doubling goal, or any efforts to implement it, PFMC's conservation objective is escapement (returning spawners) between 122,000 and 180,000, in any given year. Assuming that PFMC adheres to this position, it will be impossible to achieve the doubling goal.

Deliberate harvest levels limit potential population growth

49. Currently, ocean harvest allotments are - generally - set to permit escapement of hatchery and natural spawners ranging between 122,000 and 180,000 individuals annually.[31] The mean relative proportion of Central Valley fall-run Chinook salmon escapement to the San Joaquin Basin is 5.8% (based on GrandTab data from 1952 to 2017, including in-river and hatchery escapement to the Stanislaus, Tuolumne and Merced rivers). Assuming that harvest and subsequent escapement affects fish returning to the Sacramento and San Joaquin River basins equally, this corresponds to managing for an escapement target of 7,512 to 11,083 individuals to the San Joaquin River basin.

50. The Department of Interior (comments to the SWRCB February 8, 2011) suggested that a cohort replacement rate of 1.77 will result in doubling of the starting population size within 6 years, or two generations (assuming a 3-year life cycle). In the first generation, this would equate to total production in the San Joaquin River Basin of about 19,617 individuals (11,083*1.77). However, current management practices would allow for harvest of increased production, so escapement would not increase to grow the next generation. Consequently, total production in the San Joaquin River Basin would be "capped" at about 19,617 individuals (11,083*1.77). The doubling goal for Central Valley FRCS is 750,000. If one considers returns of 122,000 to 180,000 to the Sacramento Basin and assumes that the harvest rate is 60%, this equates to production of up

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[31] PFMC 1984

to 300,000 plus up to 19,617 for total Central Valley production of 319,617. This is only 42.6% of the doubling goal.

51. While the above calculation is clearly oversimplified, assumes a strict 3-year generation time, assumes no hatchery contribution (counted towards the doubling goal), and constant fractional escapement among the Sacramento River and San Joaquin River basins (Cosumnes and Mokelumne rivers excluded), it serves to illustrate that current escapement targets used to regulate the ocean fishery are clearly prohibitive of reaching the doubling goal.

The problem of ocean harvest is exacerbated by inaccurate forecasts

52. A recent review of the forecasting method concluded that the forecasting methods contain "substantial errors," highlighting the difficulty to accurately forecast this stock given the limited data available.[32] The preseason forecasts are calculated using the escapement of jacks (early maturing males) the previous year. Harvest is then set to population levels that are inflated as the predictive models become less accurate in light of changing (increasing) proportions of jacks in the fishery seen in California in recent years. In 12 of the last 15 years, PFMC predictions have overestimated the size of the Chinook salmon population (Figure 11), leading to higher than expected harvest rates and reduced escapement to Central Valley streams. The accuracy of preseason predictions has not improved in recent years despite PFMC making several changes to its forecasting method. In 2017, the preseason forecast for the Sacramento Basin population was 230,700; however, PFMC reported that the actual population in 2017 was only 139,997 fish, meaning that the preseason forecast overestimated the actual population by over 65%. With harvest quotas based on an inflated population estimate, the exploitation rate (percentage of the total population that is harvested) in 2017 was 68.2%, leading to the 2nd lowest escapement year on record in the Sacramento Basin. The inaccuracy in salmon escapement is a continuing concern for management of the Central Valley population, as an underestimation can impact commercial fishermen by allowing a lower catch allotment than could be supported, and an overestimation of

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[32] Winship et al. 2013

the population can lead to overfishing, high take of stocks of conservation concern, reduced escapement and subsequent low in-river abundance.

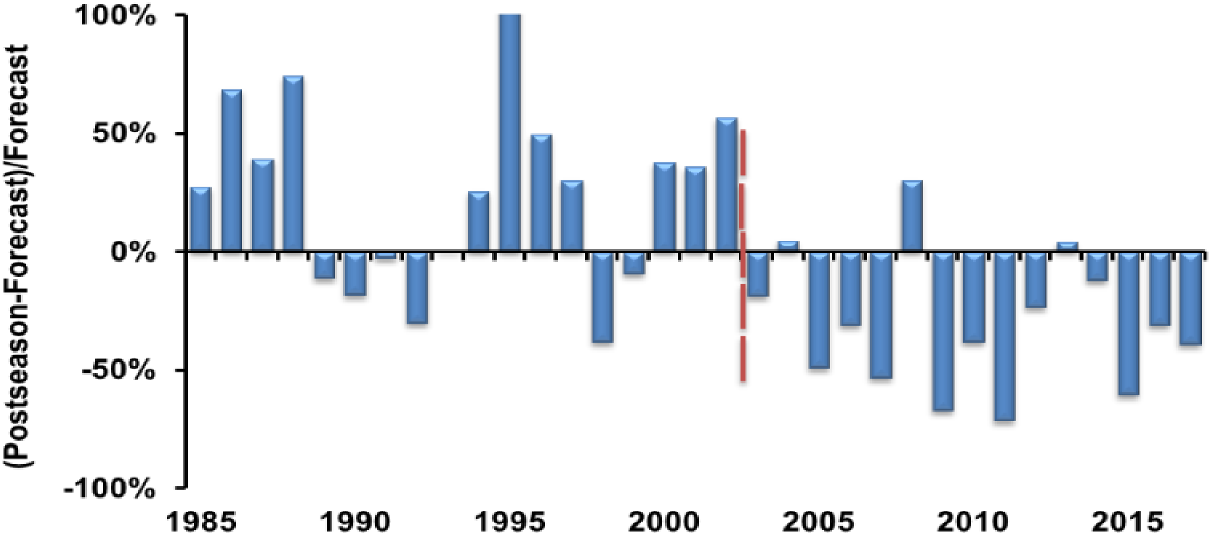

Figure 11. Percent difference from PFMC average annual preseason forecast relative to the actual SI observed, 1985-2017[33].

5. Natural production is hampered and cannot be accurately quantified due to hatchery practices

53. The doubling goal is defined as a "doubling of the natural production of Chinook salmon from the average production of 1967-1991". However, natural production during the baseline period is unknown due to hatchery contributions of undetermined magnitude, and even combined (natural and hatchery origin) escapement estimates are not well supported. Similarly, though likely improved over historic estimates, current and recent levels of natural production continue to be confounded by hatchery-produced fish, often attributable to poor hatchery practices.

54. Figure 19-1 of the State Water Resources Control Board's (SWRCB) July 2018 Draft SED purportedly shows the difference in mean estimated "natural" production of fall-run Chinook salmon in (FRCS) Central Valley streams before (1967-1991) and after (1992-2011) the Central Valley Project Improvement Act (CVPIA). For reference the figure is shown in this

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[33] PFMC 2008-2017

document as Figure 12. While the SWRCB concluded from this analysis that greater decreases in "natural" production have occurred in the San Joaquin Basin, they failed to recognize that, with the exception of Clear Creek and Butte Creek where passage barriers were removed, increases in "natural" production only occurred in streams with hatcheries.

55. The figure, however, does not include the Sacramento River, creating the misperception that decreased Chinook salmon production is (nearly) exclusive to the San Joaquin River Basin. However, the largest decreases in both estimated natural production and escapement by far have occurred in the mainstem Sacramento River (Figure 13). The average reduction in fall-run Chinook salmon production in the Sacramento River mainstem is more than double the reduction of all San Joaquin River tributaries combined. Such a large decrease – bound to affect the salmonid recovery effort the most – clearly suggests that factors other than spring-time flows in the San Joaquin basin contribute to the decline in Chinook salmon production.

56. Those tributaries depicting an increase in production are either associated with hatchery operations (Battle Creek, Feather River, American River, Mokelumne River) or large-scale restoration projects (Clear Creek and Butte Creek). The increase in adult returns to hatchery streams is likely related to the increased number of juveniles released from the respective hatcheries, which has increased by 52% from an average of 23 million during 1964-1988 to nearly 35 million during 1989-2013. While mean escapement to all Central Valley streams without hatcheries decreased slightly post-CVPIA, 2016 escapement to the Stanislaus River, a San Joaquin Basin stream, was the highest recorded since 1954, and was the fifth consecutive year of drought. This is due to a combined increase in production from the nearby Merced River Hatchery and a simultaneous shift to trucking hatchery fish to the Delta for release to circumvent high mortality rates during migration (that naturally produced FRCS experience). Trucking of hatchery origin FRCS results in an increased tendency to stray.

57. Otolith analyses and CFM show that escapement of FRCS to all Central Valley streams is dominated by hatchery origin FRCS (81-90%). The impact of hatcheries is underestimated as progeny of hatchery origin FRCS that spawned in-river are considered naturally produced.

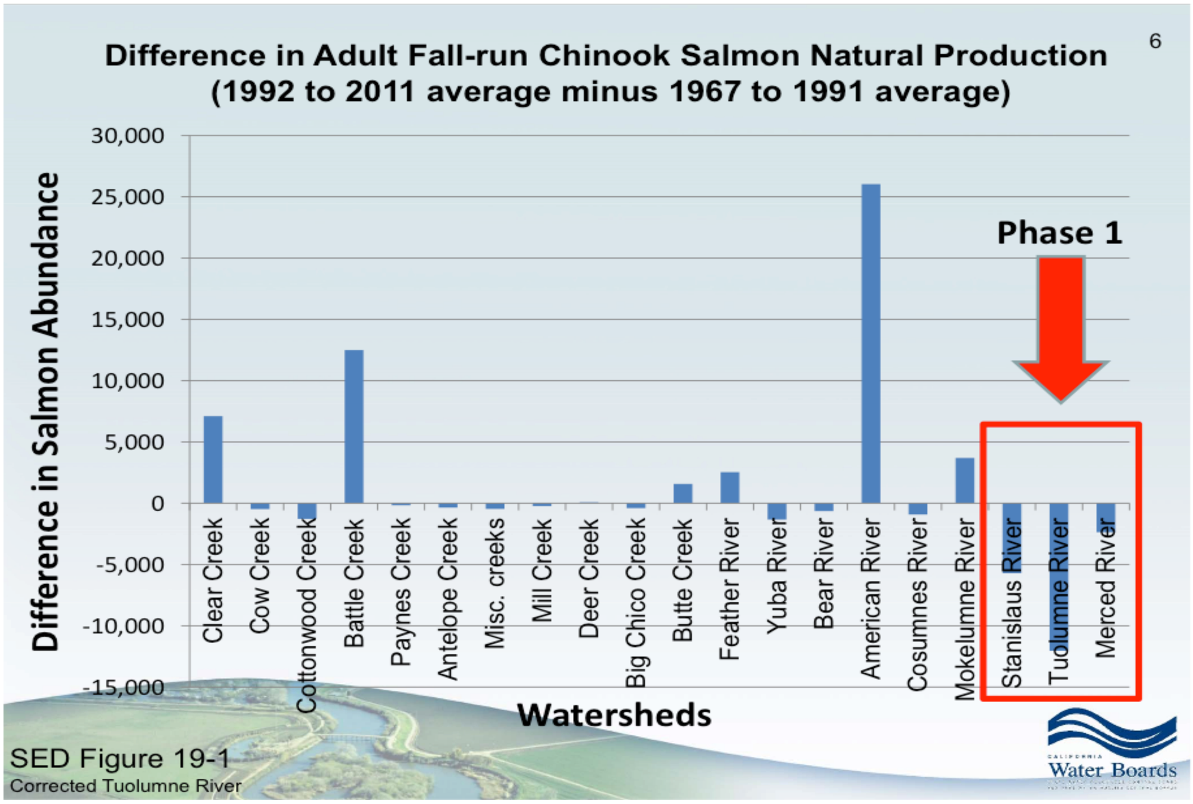

Figure 12. Difference in "natural" production of adult FRCS when comparing the 1967-1991 average to the 1992-2011 average in several Central valley streams (from SWCB staff presentation, December 2016).

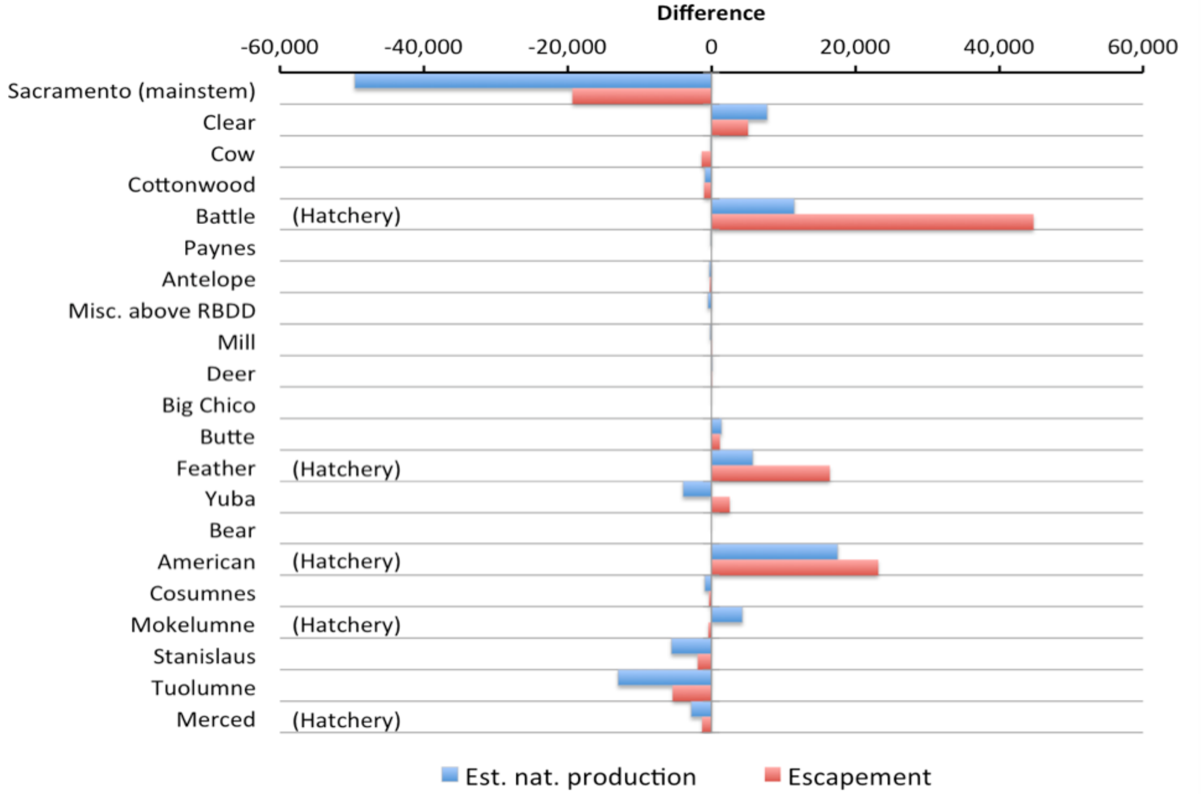

Figure 13. Differences in mean natural production and mean escapement of FRCS to between 1967-1991 and 1992-2016, including the mainstem Sacramento River.

58. Central Valley salmon hatcheries have been tasked with the nearly impossible effort of sustaining unrealistically large populations of Chinook salmon and steelhead. Broad-scale habitat degradation and destruction, and impairment of migration corridors continue to be primary factors limiting natural reproduction of these species.[34,35] However, current hatchery practices, which prioritize production and harvest over conservation of biological diversity, can also be implicated in the demise of wild fall-run Chinook. Decades of mass production (> 2 billion juveniles have been released) and off-site releases resulted in high rates of straying among tributaries, subsequently genetically homogenizing the fall-run Chinook population - hatchery and wild - through interbreeding.[36,37] Further, off-site releases to increase survival of hatchery fish exacerbates the differential survivorship with naturally spawned fish that must migrate through a gauntlet of predators. High straying and hatchery contribution to escapement along with low outmigration survival of naturally spawned fish has likely resulted in complete replacement of wild fall-run with hatchery fall-run Chinook salmon.

59. The DFCR failed to account for high hatchery contributions in escapement estimates in the San Joaquin River basin. Research published prior to 2010[38,39,40] indicated that the direct numerical contribution of hatchery Chinook salmon is likely high (>0.90 hatchery contribution in the ocean fishery) and that Central Valley fall-run Chinook salmon population were genetically homogenous. More recent research has indicated that the population-level impacts of the Central Valley hatchery system may be more severe than previously thought (i.e., synchronous population dynamics[41] and the masking of true declines in ‘natural’ Chinook stocks[42]). Without properly accounting for the hatchery contribution to tributaries in the San Joaquin River, a proper assessment

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[34] Lufkin 1996
[35] NMFS 2014
[36] Williamson and May 2005
[37] Garza et al. 2008
[38] Johnson et al. 2007
[39] Williamson and May 2005
[40] Garza et al. 2007
[41] Carlson and Satterthwaite 2011
[42] Johnson et al. 2012

of the effects of flow manipulations (or any other action conducted in freshwater) on Chinook salmon populations cannot be considered reliable.

60. The following list are critical issues with current hatchery practices that were identified by the California Hatchery Scientific Review Group:[43]

- Production goals are based on numbers of juveniles with no clear link to adult pre-fishery recruitment, harvest, or conservation goals.
- Program goals have not been clearly defined (most hatchery programs in California do not have clearly defined purposes other than juvenile production targets).
- Hatchery Monitoring and Evaluation Programs and Hatchery Coordination Teams are needed to provide accurate, timely, and objective information collected within a sound scientific framework. Despite the importance of hatchery M&E programs, they have generally received insufficient emphasis at California's anadromous fish hatcheries.
- Program size (as measured by juvenile production) has been set independent of any consideration of potential impacts of hatchery fish on affected natural populations. Therefore, hatcheries often focus more on production rather than conservation, despite the "large number of possible negative impacts that release of millions of hatchery fish may have on natural populations, including direct competition or predation among hatchery-and natural-origin juveniles, transmission or promotion of disease from hatchery to natural populations, competition between hatchery- and naturally-produced adults for spawning habitat, and reduction in fitness due to interbreeding of hatchery and naturally-produced adults on spawning grounds."
- Off-site releases improve survival rates and result in increased ocean harvest of hatchery fish, but promote unacceptable levels of straying throughout the Sacramento-San Joaquin system. Further, transporting and releasing hatchery fry to the Bay also causes higher hatchery survival relative to natural fish that suffer low survival during outmigration.

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[43] CA HSRG 2012

- No marking/tagging programs permit real-time identification of all hatchery-produced Chinook salmon, but, for the most part, consist of a constant fractional marking program in which 25% of fish produced are released with an adipose fin-clip and coded-wire tag (CWT). This marking program is adequate to allow reasonably accurate statistical estimation of the proportion of hatchery fish on natural spawning grounds and in hatchery returns and does a good job of supporting needs of fishery managers, but it does not allow real-time identification of all hatchery fish as being of hatchery origin.

The HSRG recommended that all Chinook salmon should be tagged with CWT and that 25 percent should be adipose fin-clipped to allow real-time identification of hatchery-origin fish (using electronic CWT detection devices), to enable

  - improved monitoring of hatchery and natural interactions throughout the entire life cycle,
  - culling of undesirable hatchery matings between out-of-subbasin and local stocks or between spring and fall Chinook stocks from the same basin,
  - improved management of hatchery broodstock (incorporation of known numbers of natural fish), and
  - to monitor and potentially control spawner composition in natural spawning areas.

- Standards for fish culture, fish health management and associated reporting are inadequate and need to be improved. Current practices often provide inadequate protection for both hatchery and natural fish populations from disease impacts, and fish culture protocols are outdated.
- Genetic studies on Central Valley fall-run observed genetic homogenization among wild and hatchery stocks, a direct result of the shortcomings in past (and, in some cases, current) hatchery operation. Rampant straying has resulted in genetic mixing across

tributaries such that most genetic markers cannot be used to distinguish between fall-run stocks.[44,45]

Case example of hatchery effects: escapement to the Stanislaus River

61. The effects of hatchery operations on escapement can be illustrated by example of the Stanislaus River, a river without a hatchery. On the Stanislaus River, recent estimates of hatchery contribution have been exceedingly high, based on three reports produced by CDFW[46,47,48] and updated estimates using data obtained from the Regional Mark Information System (RMIS). Since 2010 (the first year of all cohorts of spawners subjected to CFM, adopted in brood year 2006), the percentage of adipose clipped fall-run passing through the Stanislaus weir has been about 25%, except in 2011 and 2012 when the observed percentage of marked individuals exceeded 50%. During this time, the proportion of hatchery contribution to adult escapement has ranged from 50% to 99% (Figure 14). Recoveries of CWTs from Stanislaus carcass surveys are overwhelmingly from the Mokelumne River Hatchery, but CWTs from Coleman, Feather River, Nimbus, and Merced hatcheries are consistently present as well (Figure 15).

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[44] Williamson and May 2005

[45] Garza et al. 2008

[46] Kormos et al. 2012

[47] Palmer-Zwahlen and Kormos 2013

[48] Palmer-Zwahlen and Kormos 2015

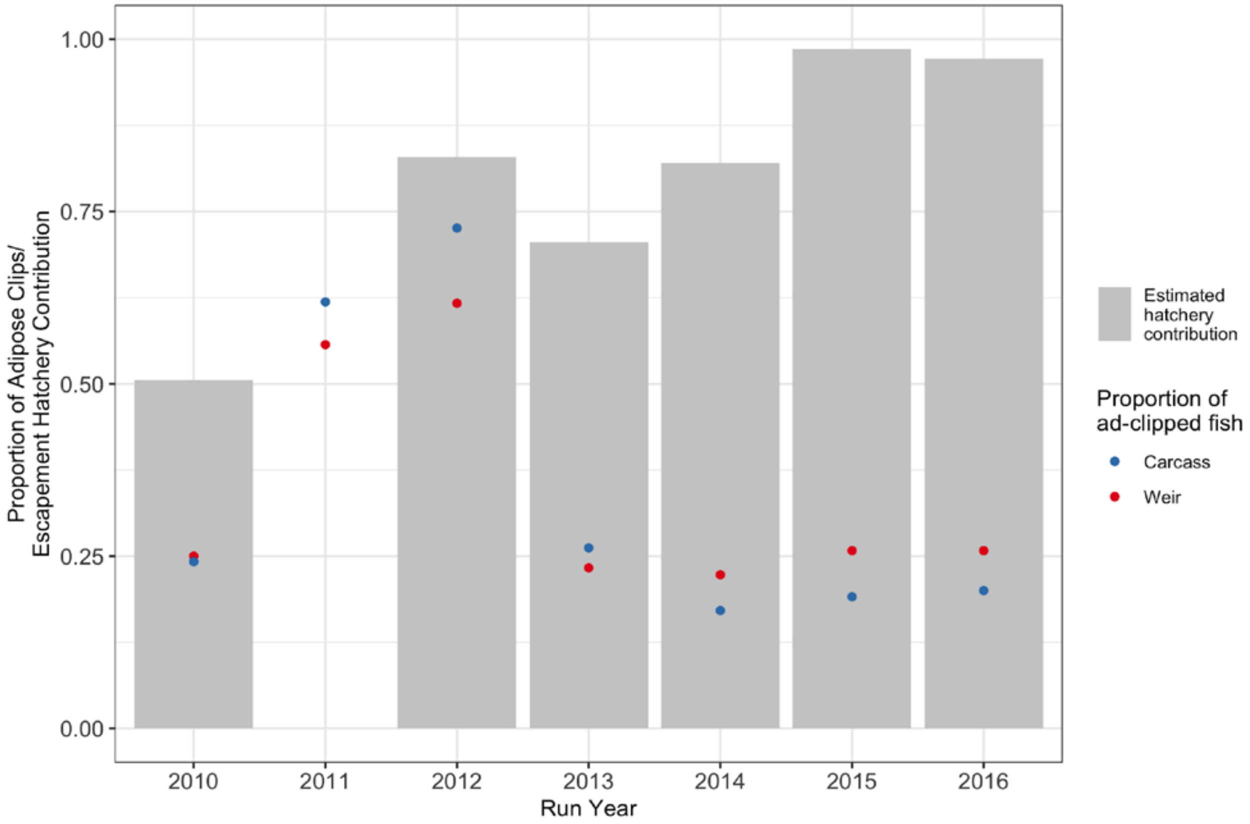

Figure 14. Estimated proportions of observed individuals with clipped adipose fins (i.e., marked as hatchery origin) from CDFW carcass surveys (blue) and from a weir and fish counting device (red) in the Stanislaus River. Grey bars show the estimated proportion of hatchery contribution to adult escapement. Data to estimate the proportion was obtained from the RMIS database.

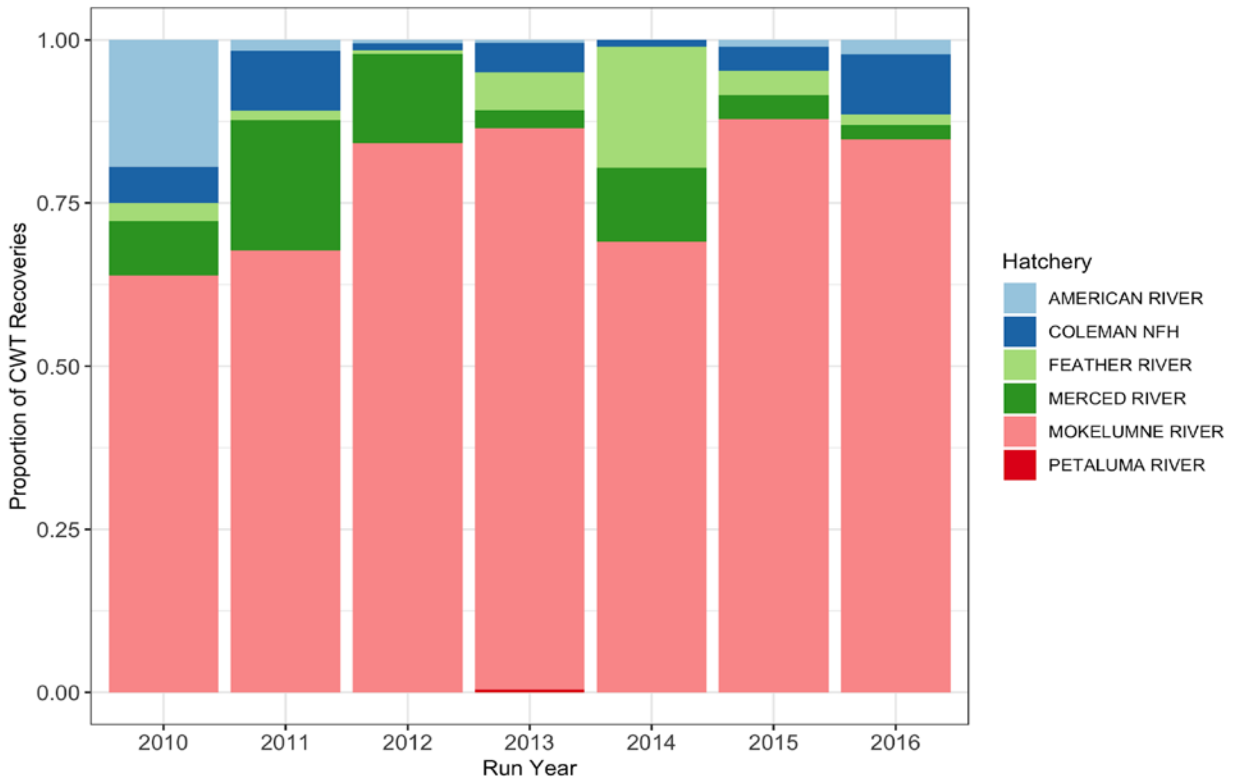

Figure 15. Hatchery of origin for CWT marked Chinook salmon observed during CDFW carcass surveys on the Stanislaus River from 2010 to 2016. Data to estimate the composition obtained from the RMIS database. Note that this figure does not reflect differences in the total number of CWTs recovered each year.

62. The improper accounting of hatchery contribution to escapement on the Mokelumne River, elsewhere in the Central Valley, and even in the Columbia River, have led to the perception that certain salmon populations are faring well when in fact, the 'natural' or 'wild' component is not.[49] Further, such erroneous perception can lead to the faulty conclusion that management actions in the freshwater environment have improved survival, production or escapement even if no such improvement occurred.

63. For example, GrandTab data for the Stanislaus would indicate a marked increase in the overall escapement over the last 20 years (1998 - 2017). However, if the estimates of hatchery contribution (recall Figure 14) are taken into account, as they should be, it becomes apparent that natural production has declined substantially, yet "escapement" has been obscured by the influx of

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[49] Johnson et al. (2012)

stray, hatchery fish. Of note, this decline occurred during management according to the 2009 NMFS Biological Opinion (BiOp; NMFS 2009, 2011), which purportedly provides improved river conditions conducive to salmonid production and survival. The perceived high escapement in recent years (2015 - 2017) consisted primarily of three-year-old adults that would have outmigrated during the years of 2013 through 2015, i.e., during the most recent drought.

Dated: July 10, 2018

DOUG DEMKO

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EXHIBIT 1

SJTA-Exhibit 402
D.Demko Part 2 Rebuttal Testimony
CWF Hearing

Doug Demko – FISHBIO President/Principal

Doug's 29 years of experience in fisheries research and monitoring, applied biology, facilitation, and negotiation have gained him the reputation of a regional fisheries expert with extensive knowledge of fish population and life-history research and monitoring. Doug is trained in biology and graduated from CalNorthern School of Law in 2001. He founded and is President of FISHBIO, Inc., a U.S. based corporation specializing in fisheries research, monitoring, and conservation. He is also the President of FISHBIO Laos Limited, a foreign company that specializes in fisheries research, monitoring, and conservation in the Mekong River Basin in South East Asia. Doug is the President of La Cuesta Roja, S.A., a Costa Rican company established to develop a research center for the purpose of conducting fisheries research, monitoring, and conservation of freshwater and marine environments in Central America. He is also the President of Roja Adventures, S.A., a Costa Rican company established for the purpose of promoting eco-tourism, education, and conservation practices in Costa Rica. Doug funds and led the development of the Mekong Fish Network (mekongfishnetwork.org), an international effort to promote research data sharing and collaboration among diverse governments and interests in the Mekong River Basin. He also funds FISHBIO's Three Rivers program, an effort to promote fisheries and environmental education for primary school children. Doug has testified as a fisheries expert witness before the U.S. House of Representatives, twice in front of the California State Legislature on Central Valley fisheries management issues, and several times before the SWRCB.

Doug began his career monitoring juvenile Chinook in the Sacramento River in 1989. His extensive technical experience with fish population research has enabled him to start and grow a company with a successful track record of developing and conducting basin-scale fish life-history monitoring programs and has led to several innovative approaches in the field of fish research, both regionally and internationally. He has established and managed a number of ongoing long-term fisheries research and monitoring programs throughout the Central Valley and has maintained client relationships for over two decades. He oversees research projects and monitoring programs domestically and internationally.

Doug has directed and managed a variety of field research and monitoring programs, including mark-recapture studies to evaluate fish survival and entrainment, mortality and behavioral studies, limiting factor analyses, salmonid outmigration and survival characterizations, and abundance and distribution analyses. His expertise includes fish life-history research and assessment; long-term population monitoring; and population dynamics of California fishes. Doug has researched, compiled, and analyzed historical databases on fish run size, spawn timing, age structure, ocean harvest rates, habitat utilization, and hatchery practices for a variety of species status reviews, and has authored status reviews for salmonid populations in California, Oregon, and Washington. He has co-authored several journal articles on California and Mekong fish populations.

Since 1991 Doug has led or been involved in numerous studies on the Stanislaus, Tuolumne, Merced, Mokelumne, and Calaveras rivers. A partial list of these efforts includes: establishing long term juvenile and adult salmon monitoring programs (rotary screw traps, seine, weirs, remote cameras, snorkel); Chinook salmon redd surveys to assess spawn timing and habitat preferences;

radio tracking juvenile Chinook to evaluate migration rates and mortality; wire fyke trapping to evaluate non-native predator species abundance; boat electrofishing to evaluate fry habitat use; boat electrofishing to remove predators from Clifton Court Forebay; Vernalis Adaptive Monitoring Program; juvenile chinook and *O. mykiss* floodplain use; floodplain habitat assessments; habitat mapping; habitat restoration; hatchery assessments; mark-recapture studies; development of a 5 year program to assess predator abundance and influence on Chinook mortality in the Stanislaus River with NOAA Fisheries and CDFW; upstream *O. mykiss* monitoring; Habitat Conservation planning; benthic macroinvertebrate assessments; migration barrier assessments; Chinook salmon stranding surveys; Watershed Stewardship Group facilitation; and volunteer snorkel surveys.

Internationally Doug's fisheries research and monitoring experience includes projects in the Mekong Basin, including projects in Laos PDR, Vietnam, Cambodia, and Thailand. A partial list of these projects include: establishing fisheries monitoring programs including programs driven by large power companies and remote villagers; establishing and studying Fish Conservation Zones; Mekong Giant Catfish satellite telemetry; use of environmental DNA to identify species; establishing and training villagers in participatory fishery monitoring surveys; developing community water quality and water resource management programs; seasonal wetlands evaluation; state of the basin assessments; climate change and aquatic organisms assessment; fisheries management plans; fish hatchery assessment; establishment of turtle conservation zones; and macroinvertebrate assessments.

Since starting FISHBIO in 2006 Doug has worked for or partnered with many private companies, public agencies, Non-Government Organizations, non-profit groups, and universities for the purposes of researching fish populations domestically and internationally. A partial list of clients, partners, and grantors includes: U.S. State Department; World Wide Fund for Nature (WWF); Mohamed bin Zayed Species Conservation Fund; International Union for Conservation of Nature (IUCN), Laos, and Critical Ecosystem Partnership Fund (CEPF); The Asia Foundation; Sustainable Mekong Research Network (SUMERNET); International Crane Foundation; Fauna & Flora International, Myanmar; Theun Hinboun Power Company; Mekong River Commission; Nam Ngiep Power Company; The Agro Biodiversity Institute; University of Nevada Reno; USAID; Wildlife Conservation Society and Turtle Survival Alliance; Chiang Mai University and International Development Research Centre; Earth Systems Mekong; United States Bureau of Reclamation; California Department of Water Resources; San Joaquin Tributary Authority; Modesto and Turlock irrigation districts, Merced Irrigation District; Oakdale Irrigation District; South San Joaquin Irrigation District; West Stanislaus Irrigation District; Banta-Carbona Irrigation District; Patterson Irrigation District; Stockton East Water District; South Valley Water Association; River Partners; Nature Conservancy; NOAA Fisheries; Monterey County Water Resource Agency; and ICF International.