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TRIBUTARIES AUTHORITY

7
 8
 9 BEFORE THE CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

10 IN THE MATTER OF

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

14)
 15)
 16 I, Doug Demko, declare as follows:

17 **SUMMARY OF CREDENTIALS**

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

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

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

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

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

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

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

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

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

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

6 OVERVIEW OF TESTIMONY

7
8 8. For this proceeding, my testimony will address deficiencies of the State Water
9 Resources Control Board's (SWRCB) 2010 report entitled Development of Flow Criteria for the
10 Sacramento-San Joaquin Delta Ecosystem that I will hereafter refer to as the Delta Flow Criteria
11 Report (DFCR). The specific basis for my rebuttal testimony, and specific case-in-chief evidence to
12 which it is responsive, is set forth in SJTA-Exhibit 404 (Declaration of Tim O'Laughlin).

13 9. The DFCR is being used to inform analysis for a change in the point of diversion of
14 the State Water Project or the federal Central Valley Project from the southern Delta to a point on
15 the Sacramento River as required by the Delta Reform Act. ~~The DFCR claims that 60% of~~
16 ~~unimpaired flow (UIF) of the San Joaquin River during February-June is needed to transport fall-~~
17 ~~run Chinook salmon (FRCS) smolts through the Delta during spring to contribute to the SWRCB's~~
18 ~~2006 Bay-Delta Plan salmon protection water quality objective (doubling goal).~~ However, there are
19 deficiencies in the DFCR analyses which, in addition to the limitations acknowledged by the
20 SWRCB in the DFCR, further restrict its utility. My testimony will discuss shortcomings of the
21 DFCR analysis, ~~and reasons why substantial increases in San Joaquin River flows cannot be~~
22 ~~expected to contribute substantially to the SWRCB's 2006 Bay-Delta Plan salmon protection water~~
23 ~~quality objective.~~ These issues are briefly summarized below, followed by more detailed discussion
24 in the following sections.

25 ● ~~The DFCR uses a nine-component 60% UIF to estimate the frequency at~~
26 ~~which 5,000 cfs and 10,000 cfs would be met at Vernalis. However, the Phase I revisions to~~
27 ~~the Bay-Delta Plan only address three of these components: the Stanislaus, Tuolumne &~~
28

1 ~~Mered River. As a result, the DFCR grossly overstates the frequency at which these flows~~
2 ~~would occur.~~

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

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

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

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

1 ~~Chippis Island would be insufficient to compensate for natural and fishing mortality at later~~
2 ~~life stages.~~

3 • Given the now significantly improved understanding of Chinook salmon
4 populations in the San Joaquin River basin and, more broadly, in the Central Valley
5 (pertaining to *hatchery operations, survival- and population dynamics*), physical
6 characteristics of the basin (*hydrodynamics, water temperature coldwater pool management,*
7 *floodplain habitat*), and existing constraints (*i.e., predation pressures, excessive ocean*
8 *harvest rates, limited in-river and Delta habitat*), DFCR flows will not substantially
9 improve Chinook salmon survival through the Delta. ~~As a direct consequence, the viability,~~
10 ~~sustainability, production, and escapement of SJR Chinook populations will not be~~
11 ~~substantially improved over the current conditions by the Petitioners' proposal for flows on~~
12 ~~the San Joaquin River (i.e., D-1641), nor by the Phase I Revisions to the Bay Delta Plan.~~

13 The DCFR and related exhibits failed to account for the underlying population dynamics of
14 the San Joaquin River population of fall-run Chinook salmon. This population is
15 characterized by a pronounced cyclic nature with boom and bust cycles that occur
16 approximately every 12 - 15 years with low periods of abundance corresponding to drier or
17 drought periods. However, the DFCR cannot substantially improve conditions during these
18 periods, which may limit long-term population abundance, and therefore has little chance of
19 improving the overall viability, abundance, or productivity of this population.

20 • ~~Implementation of the DFCR would result in frequent depletion of reservoir~~
21 ~~coldwater pools, leading to elevated in-stream water temperatures in late summer and fall.~~
22 ~~Fisheries monitoring during the recent drought demonstrated the deleterious effects of~~
23 ~~elevated temperatures on over-summering populations of threatened *O. mykiss* and fall-run~~
24 ~~Chinook salmon reproduction.~~

25 TESTIMONY

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

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

4 11. One of the biological goals of the DFCR was to provide sufficient flow ~~in the San~~
5 ~~Joaquin River~~ to transport smolts through the Delta during spring to contribute to the SWRCB's
6 2006 Bay-Delta Plan salmon protection water quality objective. As such, the DFCR considered flow
7 alone as the factor responsible for depressed production of fall-run Chinook salmon, and, by
8 extension, as the sole remedy to improve struggling salmon populations to achieve the doubling
9 goal. The DFCR does not consider additional limiting factors such as harvest allotments, predation,
10 or hatchery practices, nor does it discuss and accurately consider the limitations of physical or
11 biological responses that could be achieved by increasing flows (flow thresholds cannot be met as
12 frequently as portrayed; opportunity to inundate habitats with floodplain characteristics is extremely
13 limited within the range of managed flows). Lastly, the DFCR omits evaluation of competing
14 beneficial uses, particularly in light of the ambiguity, uncertainties, and shortcomings of portrayed
15 benefits to salmonid populations.

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

20 ~~13. First, the DFCR concluded that (1) spring flows of 5,000 cfs represent a flow~~
21 ~~threshold to substantially improve juvenile salmon survival and subsequent adult abundance, and~~
22 ~~(2) average flows of 10,000 cfs during this period may provide conditions to achieve doubling of~~
23 ~~San Joaquin Basin FRCS based on analyses of water temperatures and population growth submitted~~
24 ~~by TBI/NRDC. However, the DFCR also noted on page 121 that "additional information should be~~
25 ~~developed to determine whether these flows could be lower or higher and still meet the Chinook~~
26 ~~salmon doubling goal in the long term". In other words, there was an indication of these flows~~
27 ~~potentially representing threshold values, but the issue needed further investigation. At any rate, it~~
28

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

3 14. ~~However, as explained in the testimony of Daniel B. Steiner (SJTA Exhibit 401), the~~
4 ~~DFCR analysis used a nine-component UIF for the San Joaquin Valley as the foundation for its~~
5 ~~simulations. These include not only the unimpaired flow of the Stanislaus, Tuolumne, and Merced~~
6 ~~rivers (at reservoir), but also include the San Joaquin River at Friant, overflows from the Kings~~
7 ~~River, the Fresno and Chowehilla Rivers, and valley floor components. Limiting the requirement to~~
8 ~~only the Stanislaus, Tuolumne, and Merced rivers excludes approximately 40% of the watershed~~
9 ~~above Vernalis, resulting in much lower flows at Vernalis than the 60% UIF of the entire San~~
10 ~~Joaquin Basin as analyzed by the DFCR. Specifically, the frequency of meeting 5,000 cfs and~~
11 ~~10,000 cfs under 60% UIF decreases from 85% to 60% and from 45% to 10%, respectively~~
12 ~~(compare Figure 1 with Figure 2; see Table 1). Under the 40% UIF proposed by Phase I of the~~
13 ~~WQCP, 5,000 cfs is reached 41% of the time, but 10,000 cfs is never met (Figure 3; Table 1). For~~
14 ~~comparison, actual historical flows during 1986-2003 reached 5,000 cfs 35% of the time and~~
15 ~~reached 10,000 cfs approximately 25% of the time, which is more often than the 10% under a 60%~~
16 ~~UIF (Figure 2; Table 1). As a consequence, the population growth inferred in the DFCR cannot be~~
17 ~~expected to occur.~~

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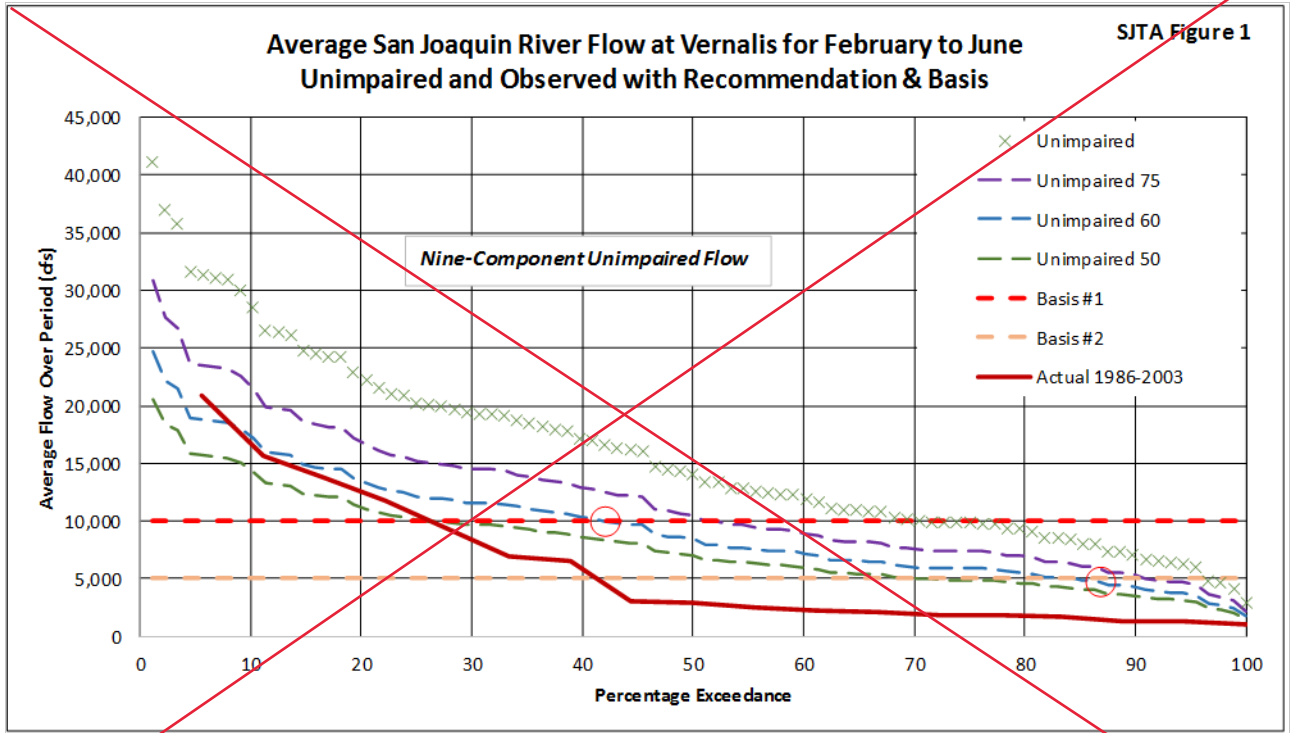


Figure 1. Frequency of occurrence of average February-June San Joaquin River flow at Vernalis. (Nine-Component Unimpaired Flow)

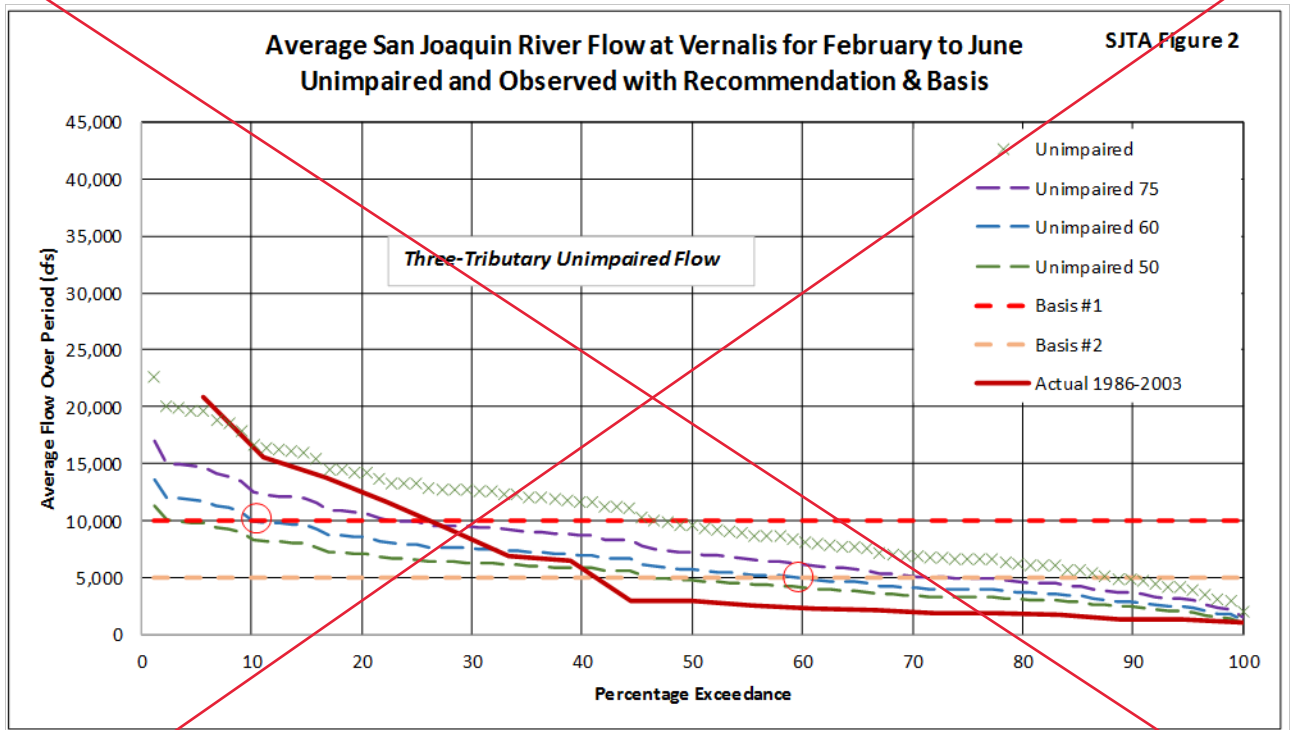


Figure 2. Frequency of occurrence of average February-June San Joaquin River flow at Vernalis. (Three-Tributary 60% Unimpaired Flow)

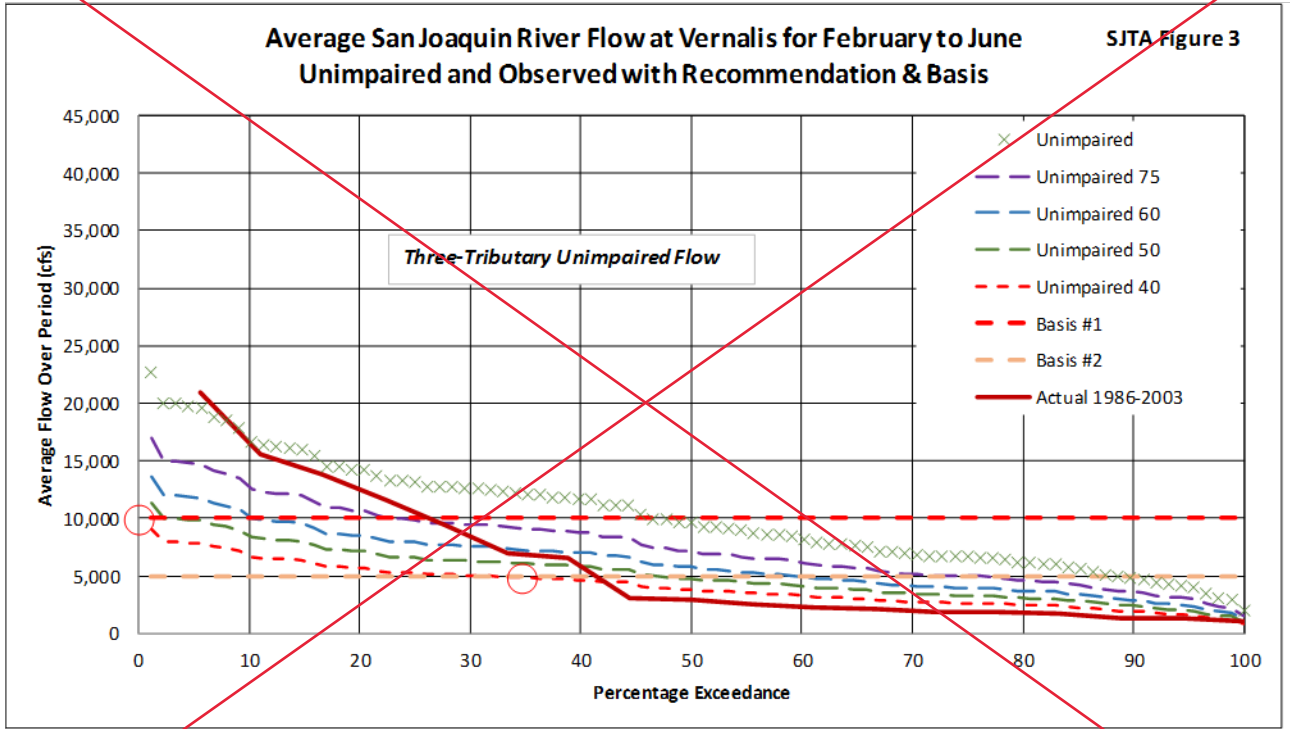


Figure 3. Frequency of occurrence of average February-June San Joaquin River flow at Vernalis. (Three-Tributary 40% Unimpaired Flow)

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.

Scenario	Frequency	
	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

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

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

20 17. ~~It may seem reasonable to assume that increased abundance at Chipps Island would~~
21 ~~generally result in increased adult abundance several years later. However, to suggest that~~
22 ~~increased, or “maximized” flows during the spring months serve to increase “production” to Chipps~~
23 ~~Island is unsubstantiated. I interpret “production” of smolts in the document to mean “survival to”.~~
24 ~~Recent scientific investigations have confirmed that high river flow cannot guarantee high survival,~~
25 ~~as survival has been demonstrated to be low, even in wet years (e.g. 2011¹).~~

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27
28

¹ Buchanan et al. 2018

1 18. ~~A third major deficiency of the DFCR is that it references results from Version 1.6 of~~
2 ~~CDFW's SalSim model as presented in CDFW Exhibit 3 as the primary basis for the San Joaquin~~
3 ~~River flow recommendations. Peer review of a more recent version of the SalSim model (Version~~
4 ~~2.0) in 2012, found that "much additional work is needed for SalSim to be management ready"², p.11.~~
5 ~~The panel detailed their concerns and provided several recommendations for improvements: "The~~
6 ~~panel was not confident that the existing model has sufficiently realistic representations regarding~~
7 ~~the effects of flow and temperature in the freshwater life stages. Better documentation and~~
8 ~~examination of diagnostics would alleviate some concerns, but several issues go beyond that. These~~
9 ~~include the focus on the San Joaquin data only; over-emphasis on flow in relationships and lack of~~
10 ~~inclusion of other covariates; and only limited results of calibration, sensitivity, and retrospective~~
11 ~~analyses being reported to date"², p. 8. The modeling results therefore do not represent best available~~
12 ~~science and provide no sound basis for the San Joaquin flow recommendations made by the~~
13 ~~SWRCB in the DFCR.~~

14 19. ~~Version 2 of the SalSim model³ was used in Chapter 19 of the SWRCB's Substitute~~
15 ~~Environmental Document (SED) for the Phase I Revisions to the Bay Delta Plan, and presumably~~
16 ~~addressed some of the problems identified with Version 1 of the model. Simulated increases in adult~~
17 ~~FRCS production on the Stanislaus, Tuolumne and Merced Rivers over the base scenario were low~~
18 ~~(9.7% in the 40% UIF, 7.6% in the 50% UIF, and 6.5% in the 60% UIF scenarios; see Table 19-32).~~
19 ~~Furthermore, these increases are, in all cases, below 10%, which the SWRCB considers "a~~
20 ~~significant benefit or impact" in other modelling scenarios (i.e. pertaining to temperature targets,~~
21 ~~Chapter 19 p. 19-18, or floodplain inundation, p 19-56). According to the SalSim results in the~~
22 ~~SWRCB's more recent WQCP/SED analysis, the flows recommended in the DFCR would not~~
23 ~~provide significantly improved salmon production.~~

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

27 _____
28 ² Anderson et al. 2012

³ AD Consultants 2014

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

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

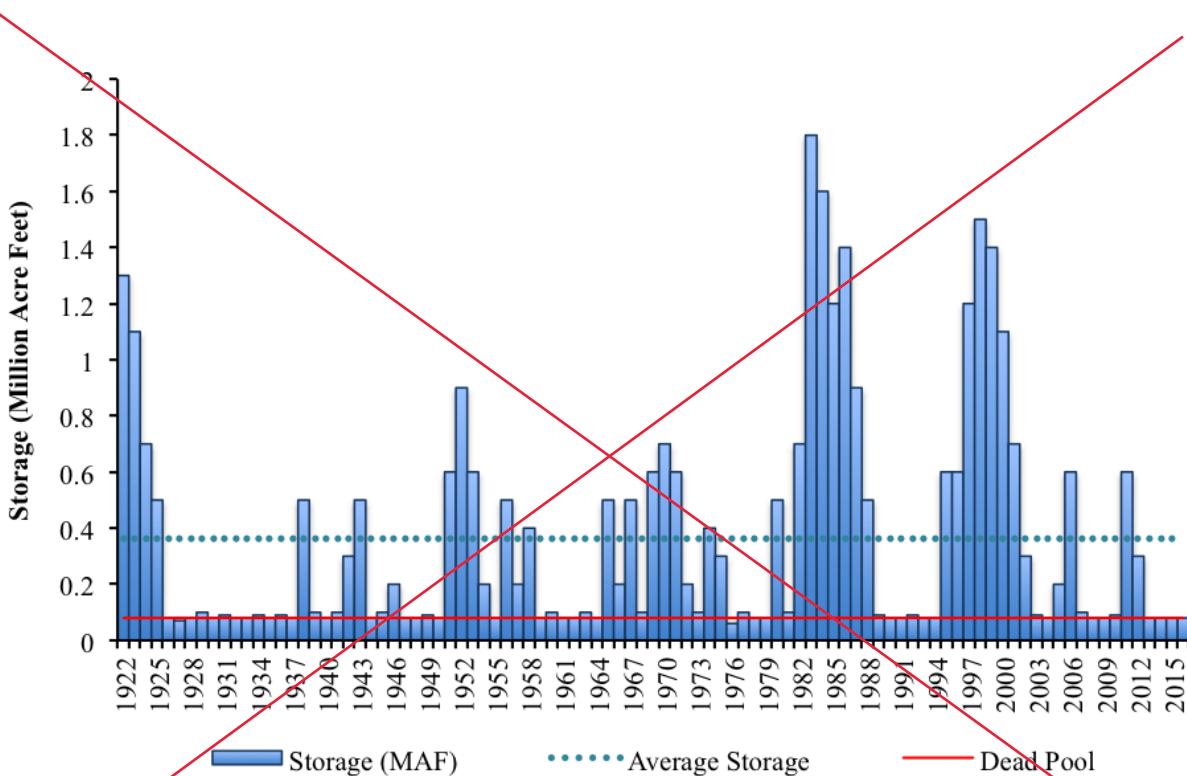
15 **~~1. Increased reservoir releases deplete coldwater storage needed to~~**
16 **~~maintain suitable water temperatures~~**

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

25 23. ~~The consequence of such management action is severely depleted reservoir storage at~~
26 ~~New Melones as shown in Mr. Steiner’s analysis if 60% unimpaired flow is required. This results in~~
27 ~~a severe reduction, or elimination, of the reservoir’s coldwater pool. Based on my experience~~
28 ~~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.~~

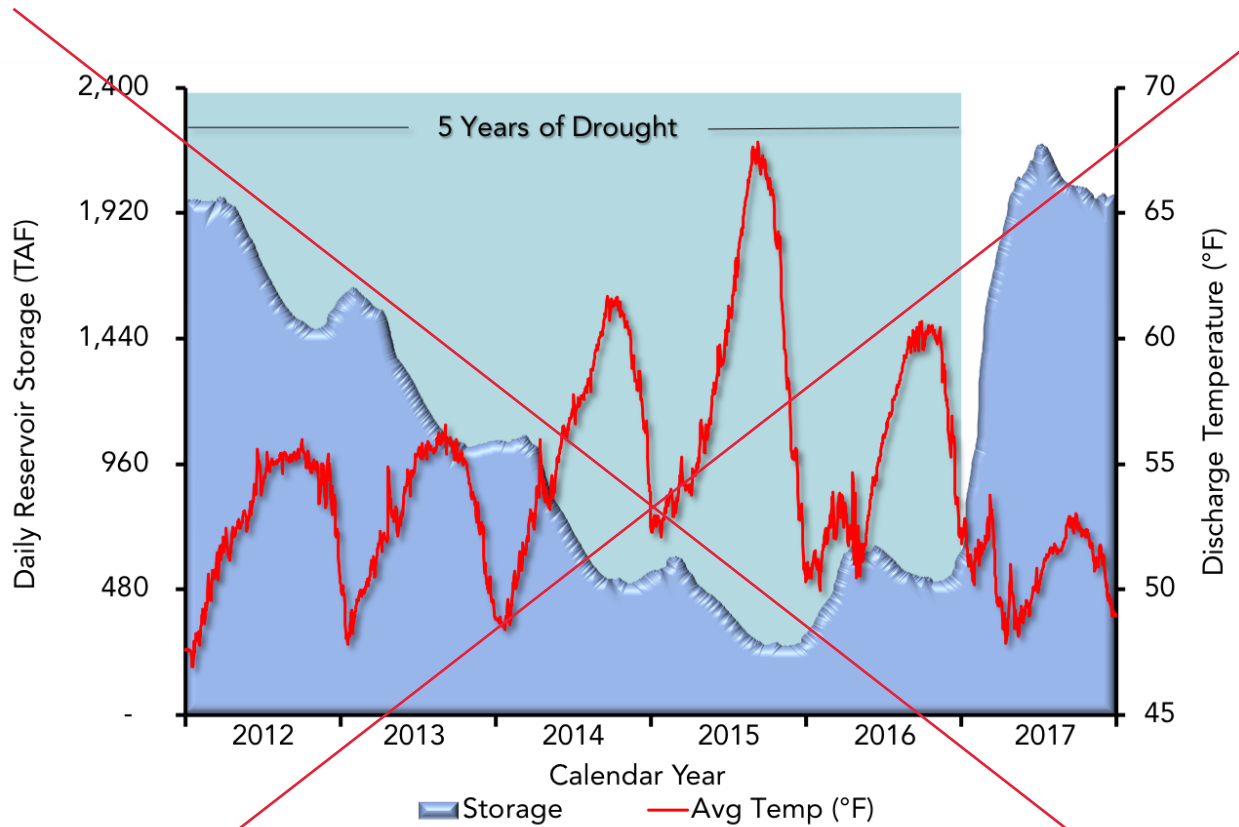


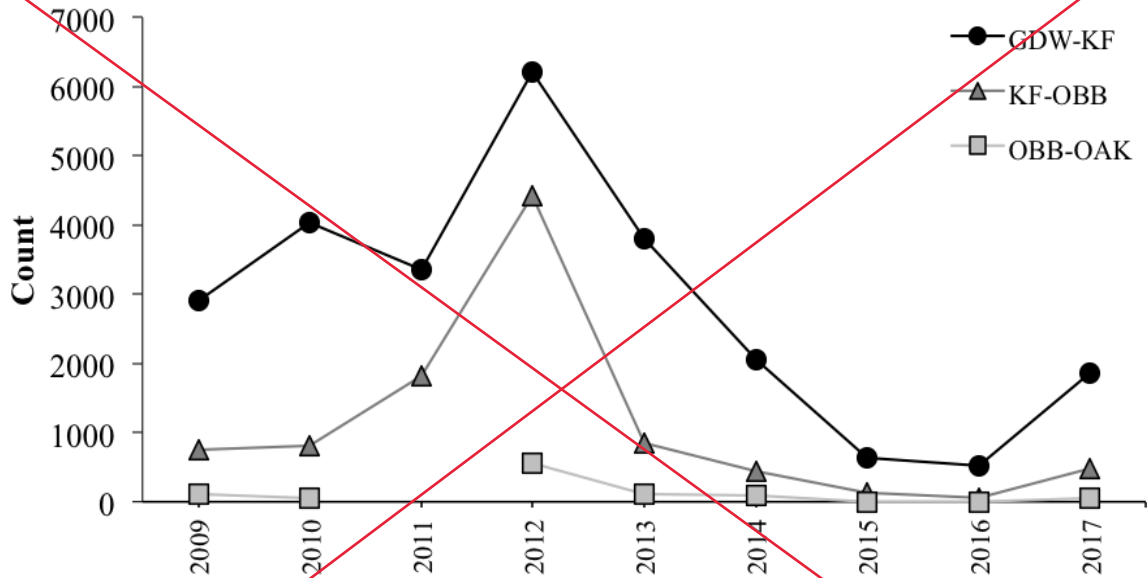
Figure 5. Relationship between average daily storage at New Melones Reservoir and mean daily water temperature below Goodwin Dam. (Source: FISHBIO hourly recording thermograph and CDEC reservoir storage for station NML)

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 habitat⁴.~~

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~~

⁴ Peterson et al. 2015

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



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

21 27. From 2009 until 2014, overall abundance averaged about 20,000 individuals,
 22 peaking in 2012 when a large number of young/small fish were observed following flood control
 23 releases and unusually cool summer water temperatures the previous year. Following this peak,
 24 overall abundance of *O. mykiss* declined sharply during drought, falling to a low of approximately
 25 5,000 in 2015 and 2016. The population began to recover in 2017 (Figure 7).

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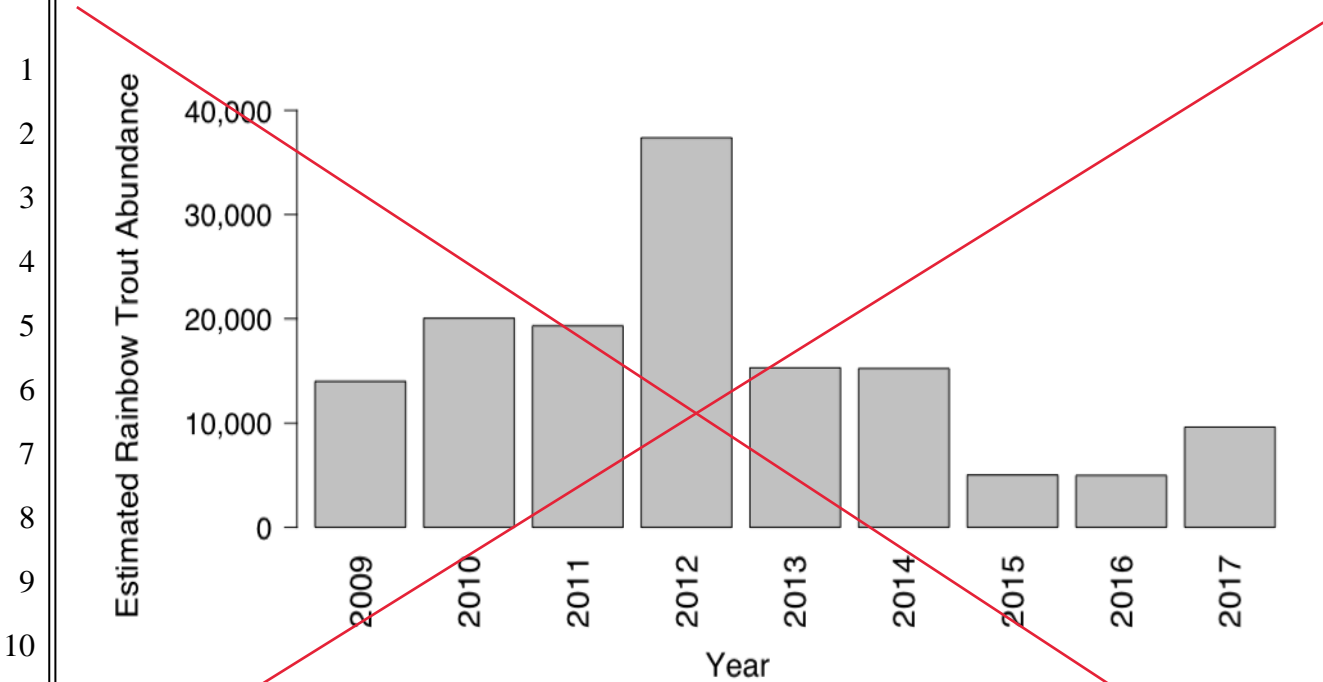


Figure 7. Annual *O. mykiss* abundance in the Stanislaus River during 2009-2017 (FISHBIO; unpublished data).

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.~~

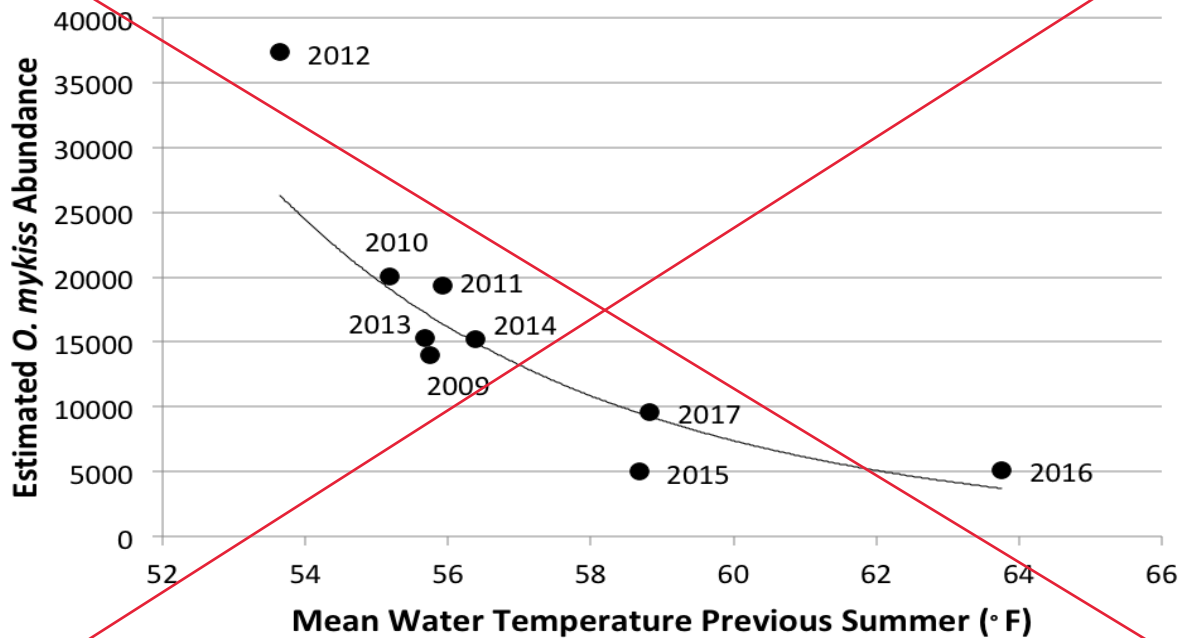


Figure 8. Abundance of *O. mykiss* in the Stanislaus River relative to the mean summer water temperature the previous year (June – August at Goodwin Dam)^{5,6}.

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 emergence⁷. 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~~

⁵ Peterson et al. 2015

⁶ FISHBIO unpublished data

⁷ Quinn 2005

1 behavioral thermoregulation if water temperatures exceed certain thresholds^{8,9}. It is especially
2 important for them to conserve enough energy to complete the spawning process. Chinook salmon
3 may begin spawning when water temperatures near 60.8°F (16°C), the upper temperature limit for
4 50% mortality.¹⁰ After arriving on the spawning grounds, female Chinook salmon tend to spawn
5 without much delay, which may serve to maximize the time guarding the red.¹¹

6 32. From 2009 to 2013, daily water temperatures from Goodwin Dam summarized from
7 October 1 to December 31 remained relatively consistent throughout the fall spawning season
8 (mean range 53.2°F – 54.1°F [11.8 – 12.3°C]). However, in 2014 and 2015, the average
9 temperatures were substantially higher during the fall (means = 57.7°F [14.3°C] and 64.0°F
10 [17.8°C], respectively). The timing of redd deposition was estimated from data collected during
11 annual redd surveys. Based on the timing of redd deposition and the patterns of water temperature,
12 during 2009 to 2013, almost all spawning was estimated to have occurred in 7DADM water
13 temperatures that were below or very close to the EPA¹² criteria for spawning Chinook salmon
14 (55.4°F [13°C]; Figure 9). In these years, daily average water temperatures typically decreased to
15 55.4°F [13°C] by early to mid-October. Due to the depletion of the coldwater pool during the
16 drought in 2014 and 2015, water temperatures often remained above 55.4°F [13°C] until December
17 in both years, which resulted in more than 95% of spawning to occur at water temperatures above
18 13°C. These observations suggest that the ability for adult Chinook salmon to adjust or delay spawn
19 timing is relatively limited relative to the ability to delay their migration rates. Notably, water
20 temperatures in 2014 and 2015 did not approach or exceed the upper thermal tolerances for adult
21 Chinook salmon¹³ and no significant pre-spawn mortality was observed during these years.

22
23
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26 ⁸ Goniea et al. 2006

27 ⁹ Strange 2012

28 ¹⁰ Alderdice and Velsen 1978

¹¹ Quinn 2005

¹² EPA 2003

¹³ Eaton and Scheller 1996

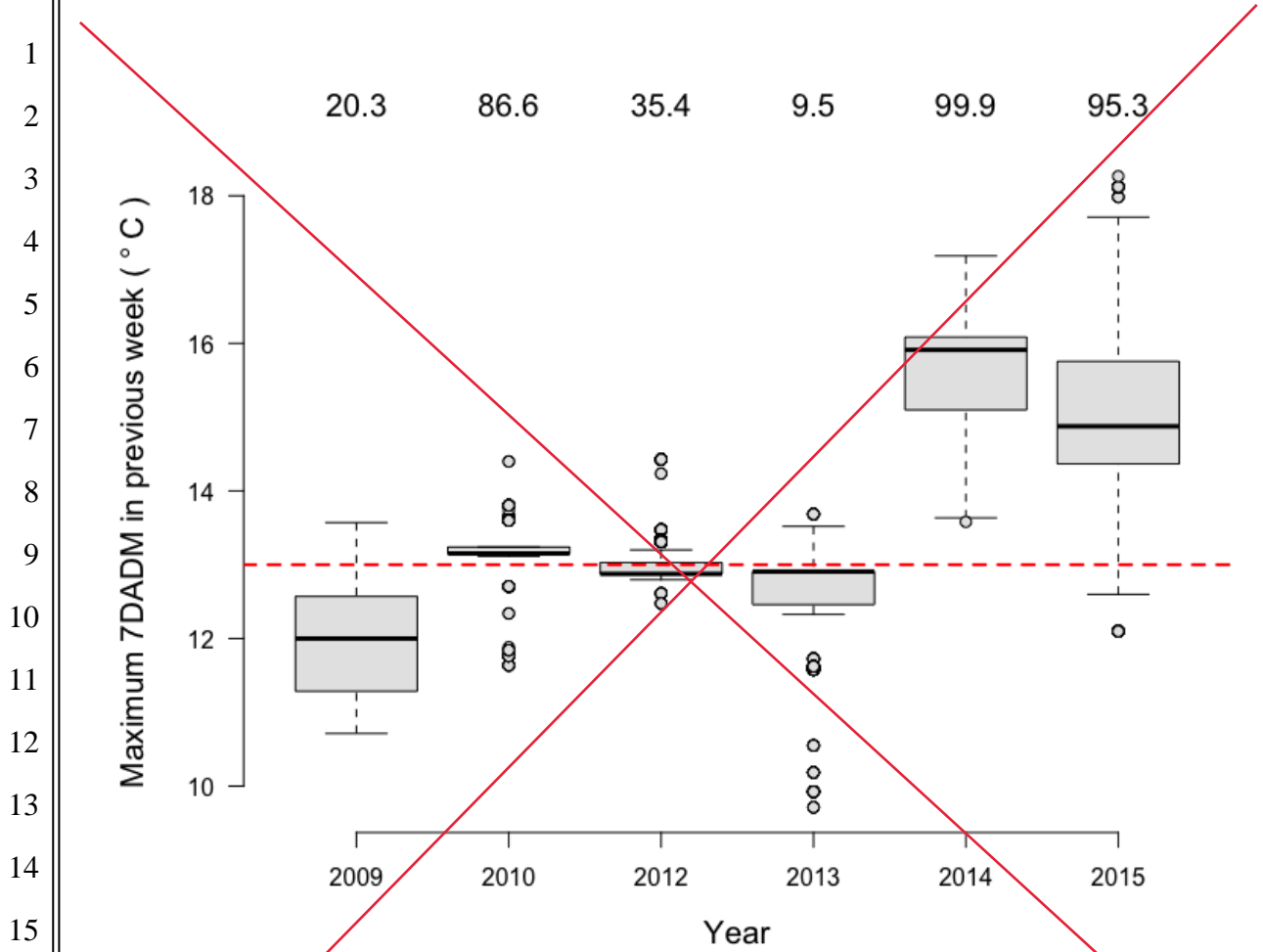
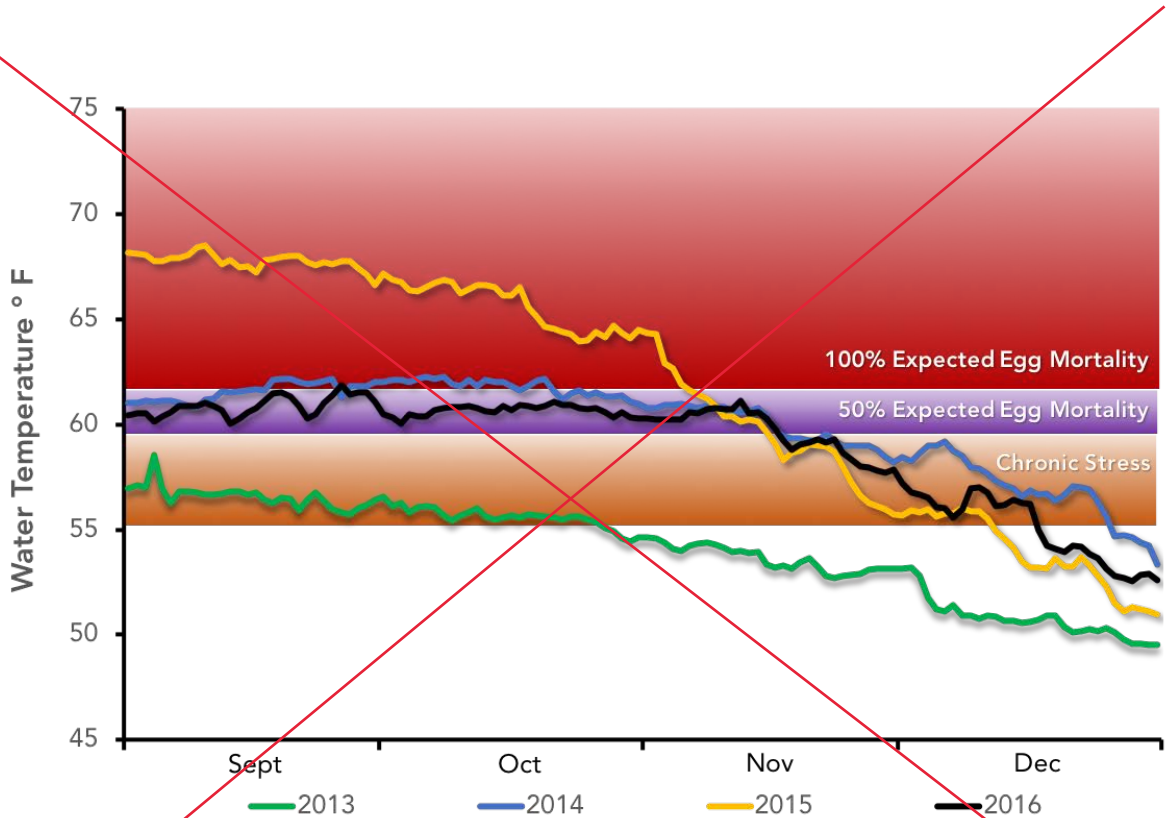


Figure 9. Distribution of Chinook salmon spawning activity (redd construction) in relation to water temperatures (7DADM; measured at Goodwin Dam [RM 58.4]) in the Stanislaus River. Horizontal red line represents 13°C [55.4°F], the recommended temperature guidance for spawning for trout and salmon (EPA 2003). Numbers across top are the estimated percentage of redds that were constructed at water temperatures greater than 13°C¹⁴.

~~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~~

¹⁴ FISHBIO unpublished data

1 ~~2014. Notably, water temperatures were far more favorable for incubation during fall 2013, and low~~
 2 ~~reservoir storage during fall 2014 resulted in high water temperatures during spawning and~~
 3 ~~incubation leading to a 70% reduction in juvenile production. These observations suggest that the~~
 4 ~~focus on improving survival in one life stage (the smolt stage by increasing flows) is likely to have~~
 5 ~~negative impacts on other life stages. It also shows that the full impact of the DFCR has not been~~
 6 ~~adequately assessed.~~



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20 **Figure 10. Stanislaus River water temperature below Goodwin Dam (RM 58.4) during fall**
 21 **spawning period 2013-2016 (note: 55.4°F is equivalent to 13°C; 60.0°F is equivalent to 15.6 °C,**
 22 **and 62°F is equivalent to 16.7°C)¹⁵.**

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

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

27
28
15 FISHBIO unpublished data

1 operation of the Head of Old River Barrier between 2000 and 2011. In the 2010 independent panel
2 review of the Vernalis Adaptive Management Program, the panel repeatedly pointed out two
3 important conclusions relevant to the Delta Flow Criteria Report.¹⁶ First, the panel pointed out early
4 on in their review that the reliance on flow alone would not consistently meet survival rates of
5 juvenile Chinook salmon in the San Joaquin River and Delta. The rationale for this conclusion was
6 that, particularly in recent years, survival rates at all flow levels was low. Since 2003, survival
7 through the San Joaquin Delta has consistently been < 12%, while flows at Vernalis ranged between
8 2,000 cfs and 27,000 cfs. This is a similar finding to that of Buchanan et al. (2018). Both this
9 conclusion of the review panel and the findings of Buchanan et al. (2018) present clear information
10 that the proposed flow regime will not reliably improve juvenile Chinook survival. This was
11 succinctly stated in the peer review panel's report: "These recent data serve as an important
12 indicator that high Vernalis flow, by itself, cannot guarantee strong downstream migrant survival"¹⁸;
13 p. 3.

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

21 36. The DFCR (p. 59) states:

22 "In analyzing the relationship between Vernalis flow and cohort return
23 ratios of San Joaquin River Chinook salmon, TBI/NRDC found that
24 Vernalis average March through June flows of approximately 4,600 cfs
25 corresponded to an equal probability for positive population growth or
26 negative population growth. (TBI/NRDC 3, p. 24.) TBI/NRDC found that
27 average March through June flows exceeding 5,000 cfs resulted in positive
28 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%

¹⁶ Dauble et al. 2010

1 of years. (*Id.*) The TBI/NRDC analysis suggests that 5,000 cfs may
 2 represent an important minimum flow threshold for salmon survival on the
 3 San Joaquin River. (*Id.*) Based on abundance to prior flow relationships,
 4 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.)”

5 37. As a recent publication asserts, increased flows are not necessarily associated with
 6 increased survival.¹⁷ Moreover, factors beyond the freshwater and estuarine habitat have been
 7 shown to exert substantial influence over salmon populations, not only in California, and not only
 8 for Chinook salmon. Locally, the most prominent and telling example is the 2007/2008 collapse of
 9 the Central Valley salmon population, attributed to unfavorable ocean conditions¹⁸ (discussed in
 10 more detail below).

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

23 39. Recent research²⁰ provides further evidence suggesting that predation, particularly in
 24 the lower reaches of the Delta, affects a large proportion of juvenile Chinook salmon, even in years
 25 when flows are high (2011). During their study, upwards of 20% to 64% of study fish (depending
 26 _____

27 ¹⁷ Buchanan et al. 2018

28 ¹⁸ Lindley et al. 2009

¹⁹ USFWS 2014

²⁰ Buchanan et al. 2018

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

5 **3. Unfavorable ocean conditions can severely limit marine survival of** 6 **Chinook salmon**

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

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

14 42. During that time, salmon must find sufficient food to survive and grow, escape
15 predation, and avoid being captured in the fishery before reaching maturity. As expected, “the great
16 majority of salmonids that migrate to sea do not return”.²³ It has long been recognized that Pacific
17 salmon, in general, experience long-term abundance trends associated with ocean-climate
18 regimes.^{22,23,24} Other research has identified the biological predictors of diatom and zooplankton
19 abundance and oceanic current conditions as important predictors of survival and growth during the
20 early ocean phase of Chinook salmon²⁵.

21 43. Until reaching maturity, Chinook salmon originating from the Central Valley largely
22 remain in the nearshore coastal waters of California, and do not travel long distances like northern
23 populations.²⁶ As a consequence, localized conditions such as wind stress and upwelling strongly
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25
26 ²¹ Quinn 2005

27 ²² Mantua et al. 1997

28 ²³ Beamish et al. 1997

²⁴ Hare et al. 1999

²⁵ Sabal et al. 2016

²⁶ Weitkamp 2010

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

5 44. In the years prior, abnormal patterns of the California Current, higher sea-surface
6 temperature and weak upwelling (both considered detrimental to Chinook salmon²⁹) were
7 implicated in various biological responses, ranging from emaciated whales and abandoned nests of
8 seabirds to unusual foraging patterns by sea lions. As expected, the unusual ocean conditions also
9 affected juvenile salmon entering or rearing in the ocean during this time. The affected salmon
10 brood years (2004 and 2005, respectively) entered the marine environment at abundance levels that
11 correspond well to the long-term averages (based on data from 1970 – 2007³⁰), yet far fewer fish
12 reached maturity and returned to freshwater spawn. Ocean mortality was identified to be the
13 proximate cause of the collapse³⁰. High mortality was attributed to a lack of food resources for
14 juvenile salmon, as the typical seasonal food web did not develop. This assertion was directly
15 supported by the poor conditions of salmon sampled in the Gulf of the Farallones. While the
16 2007/2008 escapement years were an anomaly, this example serves to demonstrate – once more –
17 that marine conditions can have profound effects of salmon survival, and factors beyond the control
18 of resource managers can ultimately determine the abundance of Chinook salmon.

19 45. In order to safeguard against drastic fluctuations in population abundance resulting
20 from unfavorable marine conditions, which are beyond the control of resource managers, steps
21 should be taken to enhance the outmigration diversity of Central Valley Chinook salmon. As the
22 Central Valley (fall-run) stock relies heavily on hatchery production, a release strategy that is more
23 diversified and coordinated among hatcheries may be the most feasible near-term action that can
24 serve to increase the resilience of the stock. Arguably, ocean survival may be somewhat lower in
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26

27 ²⁷ Wells et al. 2008

28 ²⁸ Lindley et al. 2009

²⁹ Petrosky and Schaller 2010

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

3 4 **4. Unsustainable ocean harvest rates thwart population growth**

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

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

28

³⁰ Lindley et al. 2009

1 recently “reclassified” as a candidate species for listing as threatened or endangered) under the
2 Endangered Species Act, 16 U.S.C. §§ 1531 et seq. (“ESA”) are in peril, preventing the loss of 50-
3 65 percent of the SRFC adult population due to ocean harvest would be both wise and in concert
4 with the State’s goal of doubling the production of salmon.

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

9 *Deliberate harvest levels limit potential population growth*

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

18 50. The Department of Interior (comments to the SWRCB February 8, 2011) suggested
19 that a cohort replacement rate of 1.77 will result in doubling of the starting population size within 6
20 years, or two generations (assuming a 3-year life cycle). In the first generation, this would equate to
21 total production in the San Joaquin River Basin of about 19,617 individuals (11,083*1.77).
22 However, current management practices would allow for harvest of increased production, so
23 escapement would not increase to grow the next generation. Consequently, total production in the
24 San Joaquin River Basin would be “capped” at about 19,617 individuals (11,083*1.77). The
25 doubling goal for Central Valley FRCS is 750,000. If one considers returns of 122,000 to 180,000
26 to the Sacramento Basin and assumes that the harvest rate is 60%, this equates to production of up
27

28 _____
³¹ PFMC 1984

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

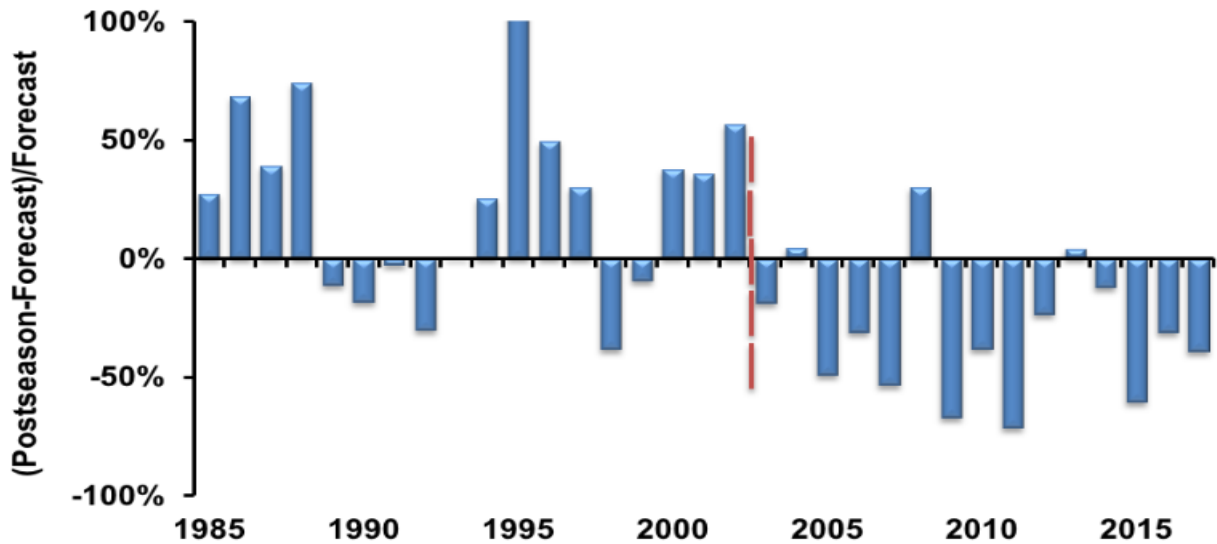
3 51. While the above calculation is clearly oversimplified, assumes a strict 3-year
4 generation time, assumes no hatchery contribution (counted towards the doubling goal), and
5 constant fractional escapement among the Sacramento River and San Joaquin River basins
6 (Cosumnes and Mokelumne rivers excluded),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

8 *The problem of ocean harvest is exacerbated by inaccurate forecasts*

9 52. A recent review of the forecasting method concluded that the forecasting methods
10 contain “substantial errors,” highlighting the difficulty to accurately forecast this stock given the
11 limited data available.³² The preseason forecasts are calculated using the escapement of jacks (early
12 maturing males) the previous year. Harvest is then set to population levels that are inflated as the
13 predictive models become less accurate in light of changing (increasing) proportions of jacks in the
14 fishery seen in California in recent years. In 12 of the last 15 years, PFMC predictions have
15 overestimated the size of the Chinook salmon population (Figure 11), leading to higher than
16 expected harvest rates and reduced escapement to Central Valley streams. The accuracy of
17 preseason predictions has not improved in recent years despite PFMC making several changes to its
18 forecasting method. In 2017, the preseason forecast for the Sacramento Basin population was
19 230,700; however, PFMC reported that the actual population in 2017 was only 139,997 fish,
20 meaning that the preseason forecast overestimated the actual population by over 65%. With harvest
21 quotas based on an inflated population estimate, the exploitation rate (percentage of the total
22 population that is harvested) in 2017 was 68.2%, leading to the 2nd lowest escapement year on
23 record in the Sacramento Basin. The inaccuracy in salmon escapement is a continuing concern for
24 management of the Central Valley population, as an underestimation can impact commercial
25 fishermen by allowing a lower catch allotment than could be supported, and an overestimation of
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³² Winship et al. 2013

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



13 **Figure 11. Percent difference from PFMC average annual preseason forecast relative to the**
14 **actual SI observed, 1985-2017³³.**

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

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

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

27
28
³³ PFMC 2008-2017

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

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

13 56. Those tributaries depicting an increase in production are either associated with
14 hatchery operations (Battle Creek, Feather River, American River, Mokelumne River) or large-scale
15 restoration projects (Clear Creek and Butte Creek). The increase in adult returns to hatchery streams
16 is likely related to the increased number of juveniles released from the respective hatcheries, which
17 has increased by 52% from an average of 23 million during 1964-1988 to nearly 35 million during
18 1989-2013. While mean escapement to all Central Valley streams without hatcheries decreased
19 slightly post-CVPIA, 2016 escapement to the Stanislaus River, a San Joaquin Basin stream, was the
20 highest recorded since 1954, and was the fifth consecutive year of drought. This is due to a
21 combined increase in production from the nearby Merced River Hatchery and a simultaneous shift
22 to trucking hatchery fish to the Delta for release to circumvent high mortality rates during migration
23 (that naturally produced FRCS experience). Trucking of hatchery origin FRCS results in an
24 increased tendency to stray.

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

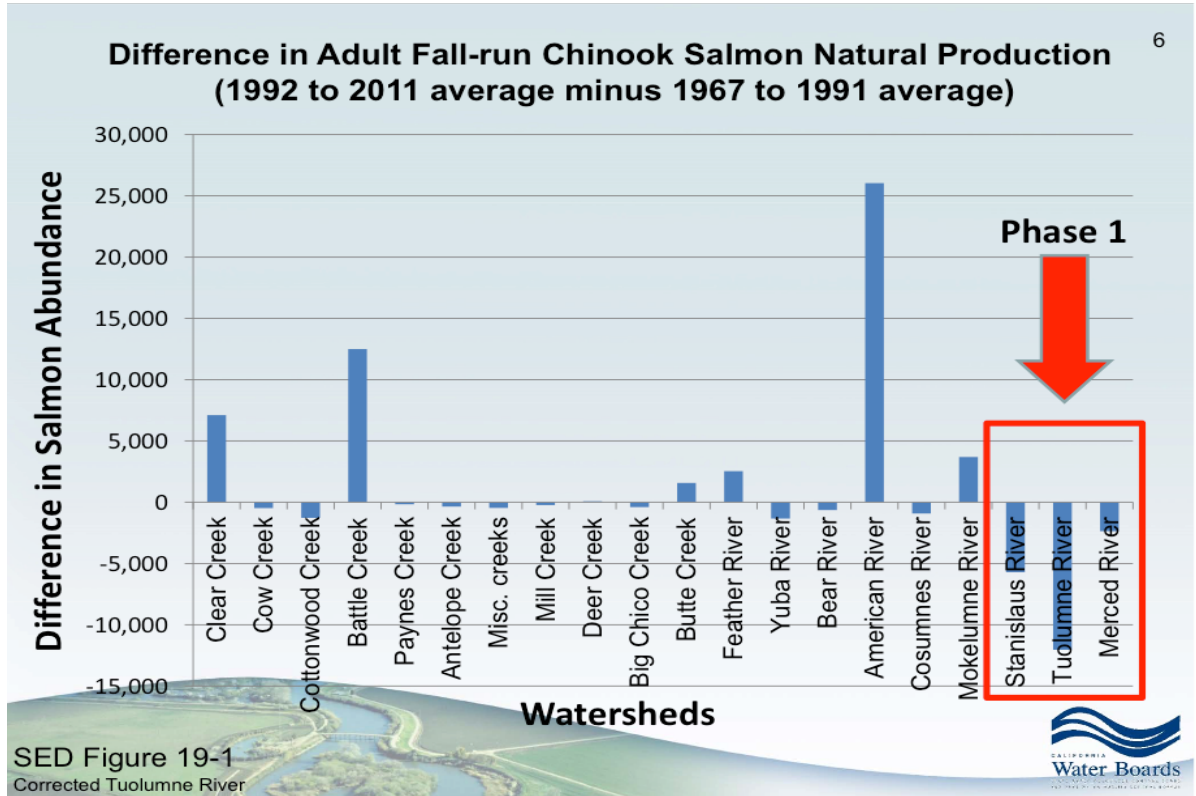


Figure 12. Difference in “natural” production of adult FRCS when comparing the 1967-1991 average to the 1992-2011 average in several Central valley streams (from SWCB staff presentation, December 2016).

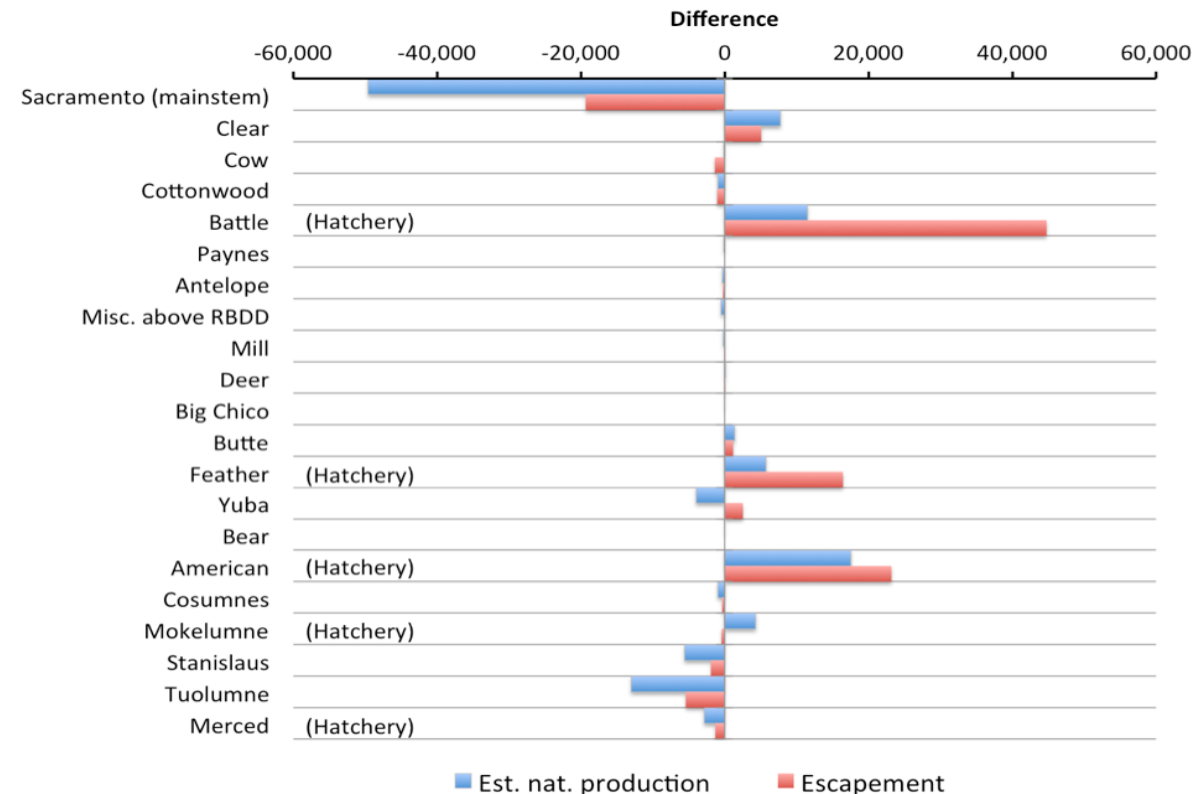


Figure 13. Differences in mean natural production and mean escapement of FRCS to between 1967-1991 and 1992-2016, including the mainstem Sacramento River.

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

14 59. The DFCR failed to account for high hatchery contributions in escapement estimates
15 in the San Joaquin River basin. Research published prior to 2010^{38,39,40} indicated that the direct
16 numerical contribution of hatchery Chinook salmon is likely high (>0.90 hatchery contribution in
17 the ocean fishery) and that Central Valley fall-run Chinook salmon population were genetically
18 homogenous. More recent research has indicated that the population-level impacts of the Central
19 Valley hatchery system may be more severe than previously thought (i.e., synchronous population
20 dynamics⁴¹ and the masking of true declines in 'natural' Chinook stocks⁴²). Without properly
21 accounting for the hatchery contribution to tributaries in the San Joaquin River, a proper assessment
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24 ³⁴ Lufkin 1996

25 ³⁵ NMFS 2014

26 ³⁶ Williamson and May 2005

27 ³⁷ Garza et al. 2008

28 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

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

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

5 • Production goals are based on numbers of juveniles with no clear link to adult
6 pre-fishery recruitment, harvest, or conservation goals.

7 • Program goals have not been clearly defined (most hatchery programs in
8 California do not have clearly defined purposes other than juvenile production targets).

9 • Hatchery Monitoring and Evaluation Programs and Hatchery Coordination
10 Teams are needed to provide accurate, timely, and objective information collected within a
11 sound scientific framework. Despite the importance of hatchery M&E programs, they have
12 generally received insufficient emphasis at California's anadromous fish hatcheries.

13 • Program size (as measured by juvenile production) has been set independent
14 of any consideration of potential impacts of hatchery fish on affected natural populations.
15 Therefore, hatcheries often focus more on production rather than conservation, despite the
16 "large number of possible negative impacts that release of millions of hatchery fish may
17 have on natural populations, including direct competition or predation among hatchery-and
18 natural-origin juveniles, transmission or promotion of disease from hatchery to natural
19 populations, competition between hatchery- and naturally-produced adults for spawning
20 habitat, and reduction in fitness due to interbreeding of hatchery and naturally-produced
21 adults on spawning grounds."

22 • Off-site releases improve survival rates and result in increased ocean harvest
23 of hatchery fish, but promote unacceptable levels of straying throughout the Sacramento-San
24 Joaquin system. Further, transporting and releasing hatchery fry to the Bay also causes
25 higher hatchery survival relative to natural fish that suffer low survival during outmigration.
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28 ⁴³ CA HSRG 2012

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

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

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

20 ● Standards for fish culture, fish health management and associated reporting
21 are inadequate and need to be improved. Current practices often provide inadequate
22 protection for both hatchery and natural fish populations from disease impacts, and fish
23 culture protocols are outdated.

24 ● Genetic studies on Central Valley fall-run observed genetic homogenization
25 among wild and hatchery stocks, a direct result of the shortcomings in past (and, in some
26 cases, current) hatchery operation. Rampant straying has resulted in genetic mixing across
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1 tributaries such that most genetic markers cannot be used to distinguish between fall-run
2 stocks.^{44,45}

3 **Case example of hatchery effects: escapement to the Stanislaus River**

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

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26 ⁴⁴ Williamson and May 2005

27 ⁴⁵ Garza et al. 2008

28 ⁴⁶ Kormos et al. 2012

⁴⁷ Palmer-Zwahlen and Kormos 2013

⁴⁸ Palmer-Zwahlen and Kormos 2015

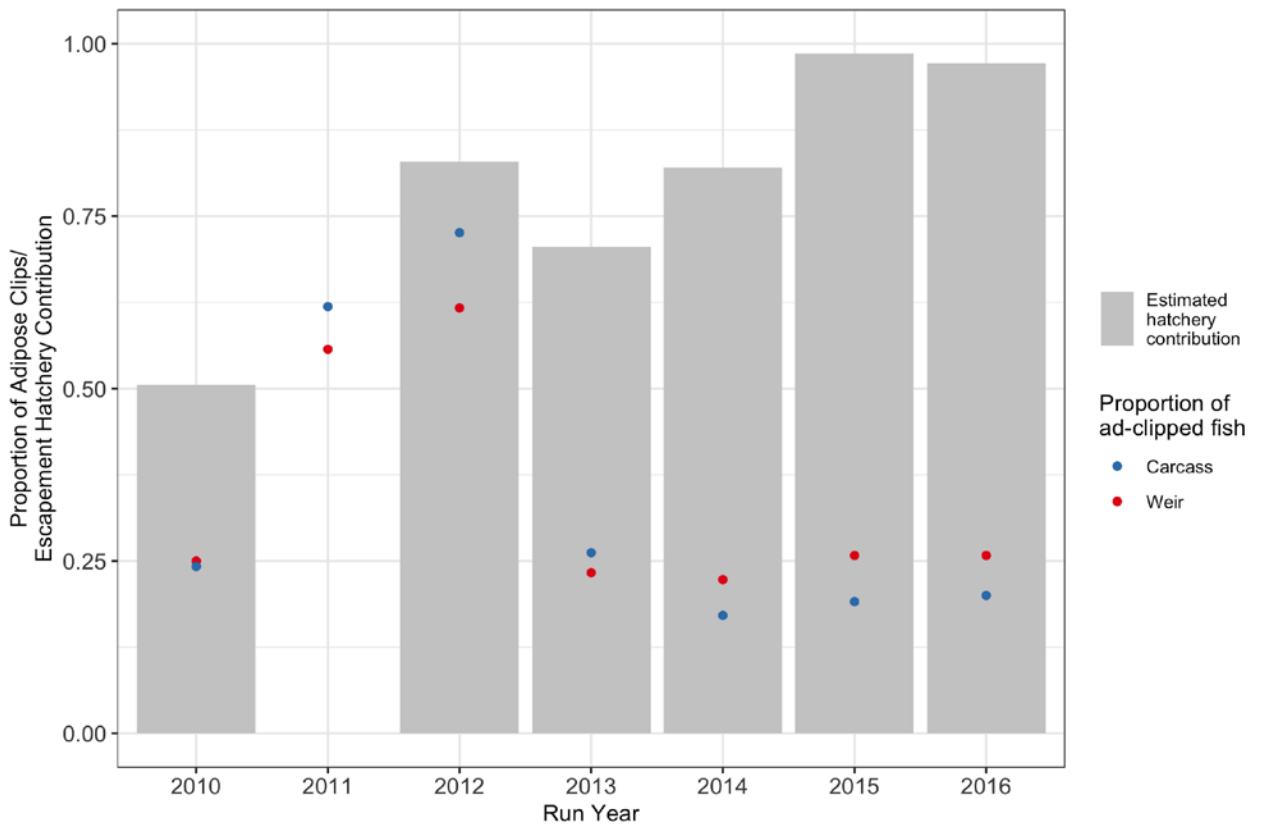


Figure 14. Estimated proportions of observed individuals with clipped adipose fins (i.e., marked as hatchery origin) from CDFW carcass surveys (blue) and from a weir and fish counting device (red) in the Stanislaus River. Grey bars show the estimated proportion of hatchery contribution to adult escapement.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

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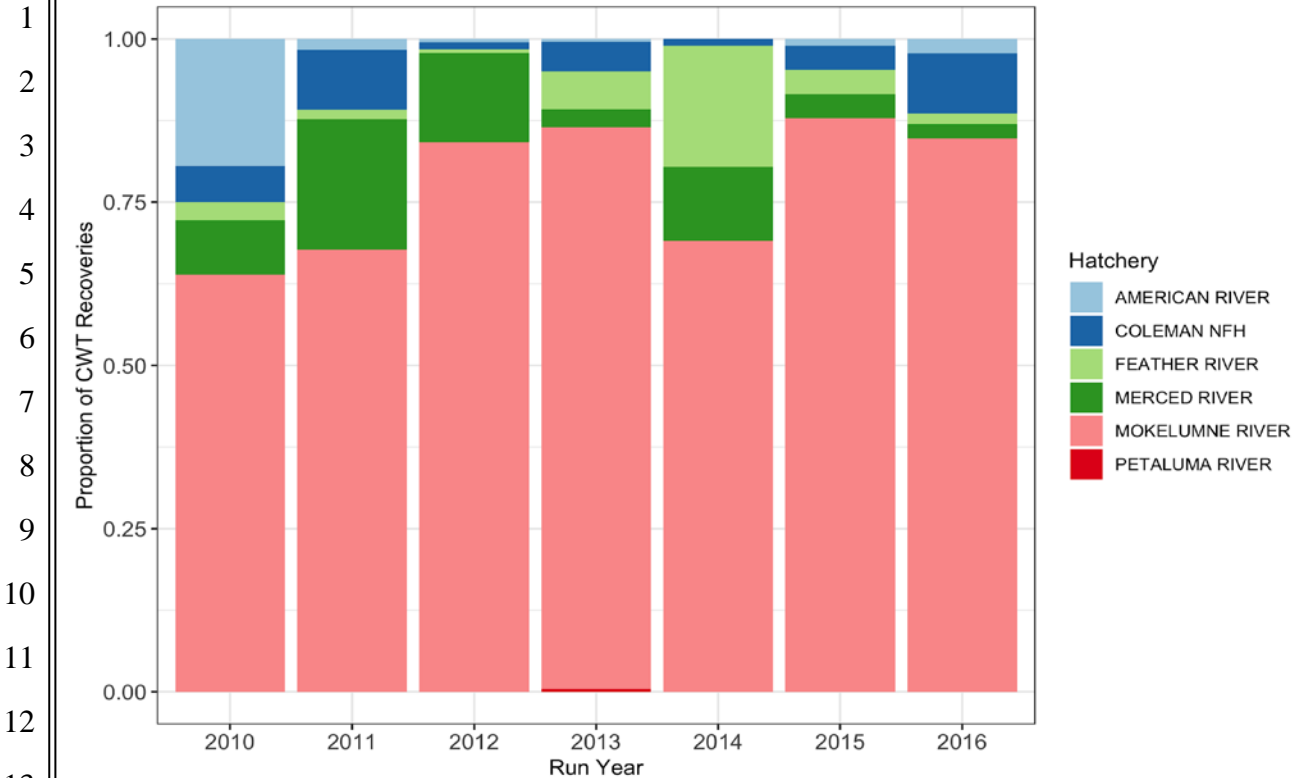


Figure 15. Hatchery of origin for CWT marked Chinook salmon observed during CDFW carcass surveys on the Stanislaus River from 2010 to 2016. Data to estimate the composition obtained from the RMIS database. Note that this figure does not reflect differences in the total number of CWTs recovered each year.

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

⁴⁹ Johnson et al. (2012)

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

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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;

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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.