STEPHAN C. VOLKER (CSB #63093)
ALEXIS E. KRIEG (CSB #254548)
STEPHANIE L. CLARKE (CSB #257961)
DANIEL P. GARRETT-STEINMAN (CSB #269146)
JAMEY M.B. VOLKER (CSB #273544)
LAW OFFICES OF STEPHAN C. VOLKER
1633 University Ave
Berkeley, California 94703
Tel: 510/496-0600
Fax: 510/845-1255

Attorneys for PCFFA and IFR

BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF THE CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX	**TESTIMONY OF NOAH OPPENHEIM**

I, NOAH OPPENHEIM, do hereby declare:

I. INTRODUCTION

My name is Noah Oppenheim. I am presenting this testimony on behalf of the Pacific Coast Federation of Fishermen's Associations (PCFFA) and the Institute for Fisheries Resources (IFR) in this evidentiary hearing before the State Water Resources Control Board (State Water Board) concerning the petition to change the point of diversion for the California WaterFix for the State Water Project (SWP) and federal Central Valley Project (CVP), as specified in the licenses and permits of the U.S. Bureau of Reclamation (USBR) and the California Department of Water Resources (DWR). I am the Executive Director of PCFFA and IFR. My statement of qualifications can be found at Exhibit PCFFA-160.

II. CALIFORNIA CENTRAL VALLEY SALMON LIFE HISTORIES AND THE IMPACTS OF EXCESSIVE DIVERSIONS THERETO

The Sacramento River Chinook salmon are divided into four life histories by time when the adults enter fresh water: fall, late fall, winter and spring run.

The Department of Fish and Game (now Department of Fish and Wildlife, DFW) developed a conceptual model of Chinook salmon and steelhead life histories in 2008 as part of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The models were intended to be used in the Bay-Delta Conservation Plan and are now used in assessing recovery actions under the Ecosystem Restoration Program. The Chinook salmon and steelhead DRERIP conceptual life history model was compiled by John G. Williams, the former Executive Director of the Bay-Delta Modeling Forum, and a former special master for instream flow criteria. Williams' report on Chinook salmon and steelhead was peer reviewed in 2010. It is submitted as exhibit PCFFA-133.[1] Williams' C.V. was submitted to the Board in another proceeding, it is resubmitted as exhibit PCFFA-134.

Table 5 of the DRERIP report (Exhibit PCFFA-133), from page 25, shows the time of spawning of the different runs:

Run:	5% by	Peak	95% by
Fall	**mid-Sep. to late Oct.**	**Mid-Oct to late Nov.**	**early Nov. to late Dec.**
Late-fall	**early to late Dec.**	**late Dec. to late Jan.**	**late March to early April**
Winter	**early to mid-May**	**early June to early July**	**early to mid-August**
Spring	**late Aug. to early Sept.**	**Sept. to early Oct.**	**mid to late Oct.**

Fall and late fall run spend the shortest amount of time in the rivers and streams, generally spawning fairly soon after they reach the spawning grounds. These are the only Sacramento River Chinook salmon runs that are not on the Endangered Species list. Winter and spring run hold in fresh water for several months prior to spawning, and have been vulnerable to lethal temperature fluctuations.

---

[1] Williams, G. J. 2010. Life History Conceptual Model for Chinook salmon and Steelhead. DRERIP Delta Conceptual Model. Sacramento (CA): Delta Regional Ecosystem Restoration Implementation Plan. Obtained from https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=28422

All Sacramento River Chinook salmon runs are genetically related, with fall and late fall runs being most closely related to spring runs. Figure 15 on p. 24 of the DRERIP report (Exhibit PCFFA-133) shows the genetic tree.

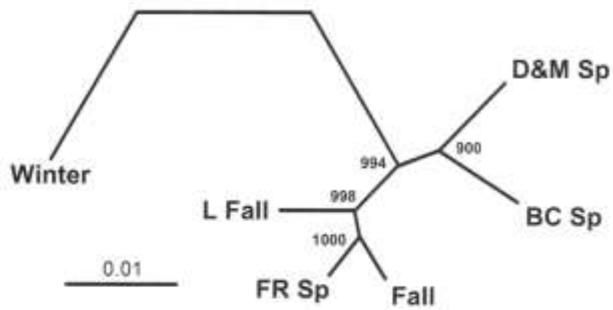
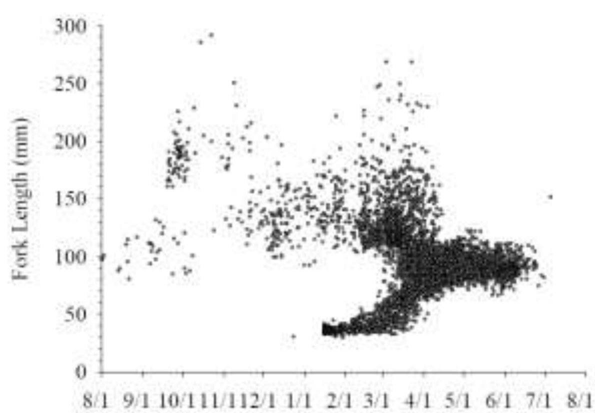


Figure 15. Genetic relationships among runs of Central Valley Chinook, based on distances (Cavalli-Sforza and Edwards) calculated from 12 microsatellite loci. The clustering analysis (UPGMA) distinguishes spring-run from Deer and Mill creeks (D&M Sp) and Butte Creek (BC Sp). Numbers next to nodes show the number of bootstrap trees, out of 1,000, showing this node. Nominal spring-run from the Feather River (FR Sp) group close to fall-run. Other genetic studies, reviewed by Hedgecock et al. (2001) have produced similar results. Copied from Hedgecock 2002.

Salvage data from the CVP and SWP diversion facilities show that juvenile salmon migrate through the Delta starting in August, and continuing through June, when the Delta becomes too warm for their survival. Figure 30 from page 46 the DRERIP report, Exhibit PCFFA-133, shows juvenile salvage in the Delta over a six year period from 1995-2001:

Figure 30. Juvenile Chinook at the Delta diversions; size at date of 6,752 juvenile Chinook sampled at the CVP and SWP diversion facilities in the Delta from August 1995 through July 2001. Data from Hedgecock (2002).



DNA testing has shown that fall run salmon comprise approximately 85% of natural salmon production and late fall run compose another 4-5%. DNA analyses of juvenile salmon caught at Chipps Island between 2008 and 2011 found that fall run were between 84.0% and

92.8% of unclipped juveniles, and late-fall run were 1.9% to 4.4%. (Exhibit PCFFA-135, Miller et. al. 2010[2]) DNA testing of unclipped Chinook salvaged at the state and federal Delta pumps from 2004 to 2010 found 86.7% fall run, 7.1% winter run, 4.7% late-fall run and 1.4% spring run. (Exhibit PCFFA-136, Harvey et. al. 2013 [3].) The Sacramento River fall run are the backbone of the West Coast salmon fishing industry.

Fall run spend different amounts of time rearing in streams before migrating to the Delta. Some migrate as fry and rears for 1-3 months in the Delta. This has historically been the most common life history. According to the 2010 DRERIP report (Exhibit PCFFA-133):

> Fry migrants to the Delta also migrate downstream soon after emergence, but remain in the Delta and rear there before migrating into the bays. This is probably the most common life history pattern among juveniles, based on monitoring passage into the lower rivers (e.g. Figure 18), but the percentage that survive is unknown. Presumably, Chinook following this life history historically reared in the then-abundant tidal habitat in the Delta (Williams 2006). (p. 29)

The other life history for fall run are those that rear upstream for a few months, and then outmigrate as fingerlings. This is also the life history displayed by hatchery fish. The 2010 DRERIP report (Exhibit PCFFA-133) states:

> Fingerling migrants remain in gravel-bed reaches for a few months, and then migrate as larger (generally > 60 mm) parr or silvery parr, in late spring if they are fall-run. The second, smaller May mode in Figure 18b reflects this life history, which is followed by a larger proportion of the juveniles in the Mokelumne River and San Joaquin River tributaries than in the Sacramento River and tributaries, although there is considerable variation from year to year in the proportions (Williams 2006, Figure 20). The larger migrants are often called smolts, although few of them have reached this stage physiologically (e.g., Snider and Titus 2001). This life history pattern has received the most attention from managers. For example, most of the USFS coded-wire tag survival studies apply to this group. The life history of hatchery fall Chinook released into the river also approximates this pattern, since the hatchery fish are released at generally > 65 mm and most move rapidly downstream. Some move downstream very rapidly, in hatchery trucks, and are released into the bays, to avoid mortality in the Delta (Williams 2006).

---

[2] Miller, J., Gray, A. Merz, J. (2010) Quantifying the contribution of juvenile migratory phenotypes in a population of Chinook salmon *Oncorhynchus tshawytscha*, Mar Ecol Prog Ser 408:227-240. Obtained from https://doi.org/10.3354/meps08613

[3] Harvey, B, Stroble, C. (2013) Comparison of genetic versus Delta Model Length-at-Date race assignments for juvenile Chinook Salmon at state and federal south Delta salvage facilities, California DWR. Obtained from http://www.water.ca.gov/aes/docs/1-ChinookGenetics_Final%20Report%20for_publication_2013-10-01_SERIF.pdf

The National Marine Fisheries Service Biological Opinion (NMFS BiOp) (Exhibit SWRCB-106) recognizes that fall and late fall-run Chinook can be present in the Delta from December through August:

> Juvenile fall-run Chinook salmon from the Sacramento River basin are expected to be present in the Delta from December through August, based on Sacramento trawl data for RM 55 (https://www.fws.gov/lodi/juvenile_fish_monitoring_program/jfmp_index.htm). (p. 583)

and

> Juvenile late fall-run Chinook salmon are present at the NDD intake locations year-round, but in relatively low numbers compared to the other runs. The smallest fry can start appearing in early April at approximately 20 to 30 mm. Fish tend to get larger as the year progresses, with the largest fish (yearlings) arriving in late fall and winter based on Sacramento trawl data for RM 55 and beach seine data (https://www.fws.gov/lodi/juvenile_fish_monitoring_program/jfmp_index.htm). (p. 585.)

However, the NMFS BiOp relies entirely on data from the drought years of 2012-2016 to estimate that only about 3% of fall run salmon migrate to the Delta as fry:

> Based on recent data from the DJFMP monitoring efforts (2012-2016), 443 out of 14,855 fish captured in the Sacramento trawl and identified as fall-run by size were 32 mm or smaller (2.98 %). An equivalent percentage of fall-run captured in the beach seines were 32 mm or smaller (378 fish out of 13,078 identified as fall-run by size; 2.9%). Therefore, approximately 2.94% of fall-run Chinook salmon captured in the Sacramento trawl and regional beach seines were 32 mm or less in fork length, which will be used as an estimate of the percentage of the fall-run Chinook salmon population that is vulnerable to entrainment at the NDD fish screens. (Exhibit SWRCB-106, p. 583-584.)

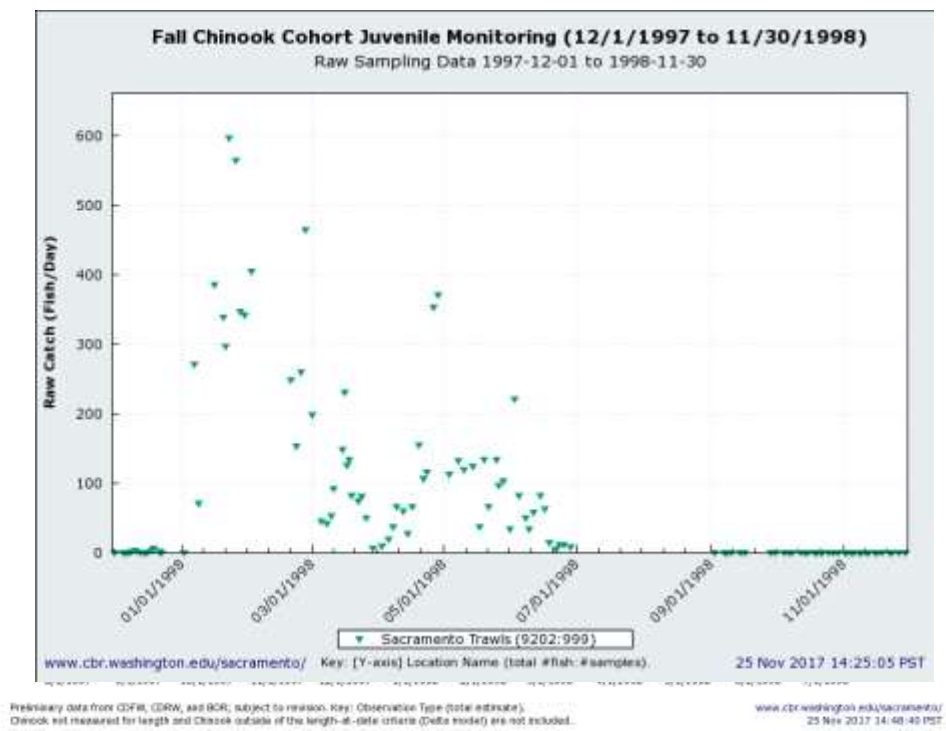
The years from 2012 to 2016 included one of the most severe droughts in the historical record, as well as several years in which D-1641 protective flow requirements were relaxed. In 2014, there was a loss of temperature control below Shasta dam and winter and fall run salmon experienced lethal temperatures. (Exhibit PCFFA-137 is a copy of the 2015 report from the US Geological Survey Water Center, titled, "Drought River Temperatures Potentially Dangerous for Fish."[4]). NMFS Southwest Fisheries Science Center later found that in 2014 and 2015, temperatures caused the loss of 77% and 85%, respectively, of winter run. (NMFS 2016 letter to USBR, Exhibit PCFFA-138.) These years were not typical conditions for salmon.

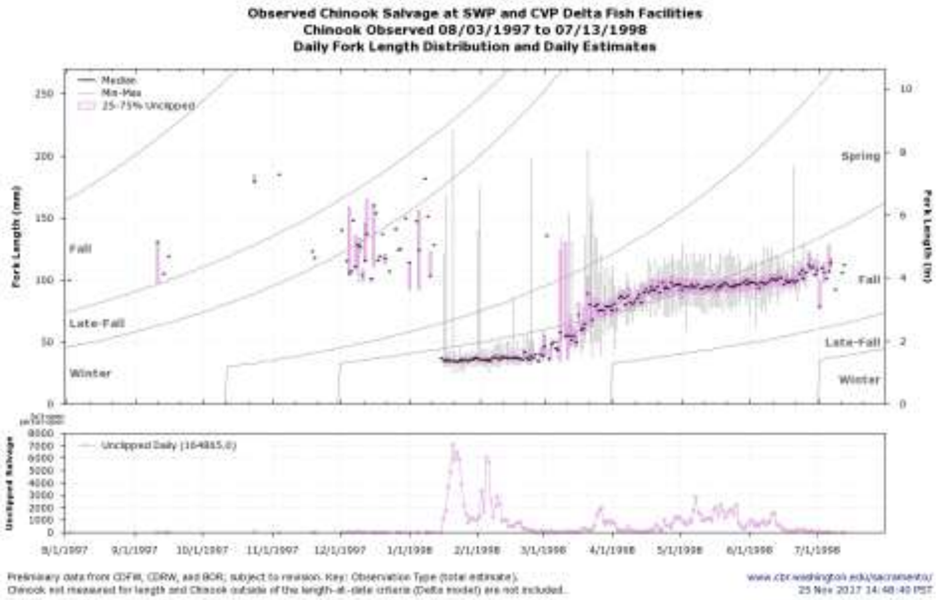
[4] Obtained from https://ca.water.usgs.gov/highlights/2015/09/drought-river-temperature-dangerous-fish

The University of Washington provides monitoring and assessment of Chinook salmon under contract with USBR. Their website is called, SacPas: Central Valley Prediction and Assessment of Salmon through Ecological Data and Modeling for In-Season Management. The website has graphs of monitoring data and length at date salvage charts for juvenile salmon. The graphs are derived from the GrandTab database of Chinook salmon data maintained by DFW, which is submitted as exhibit PCFFA-139.

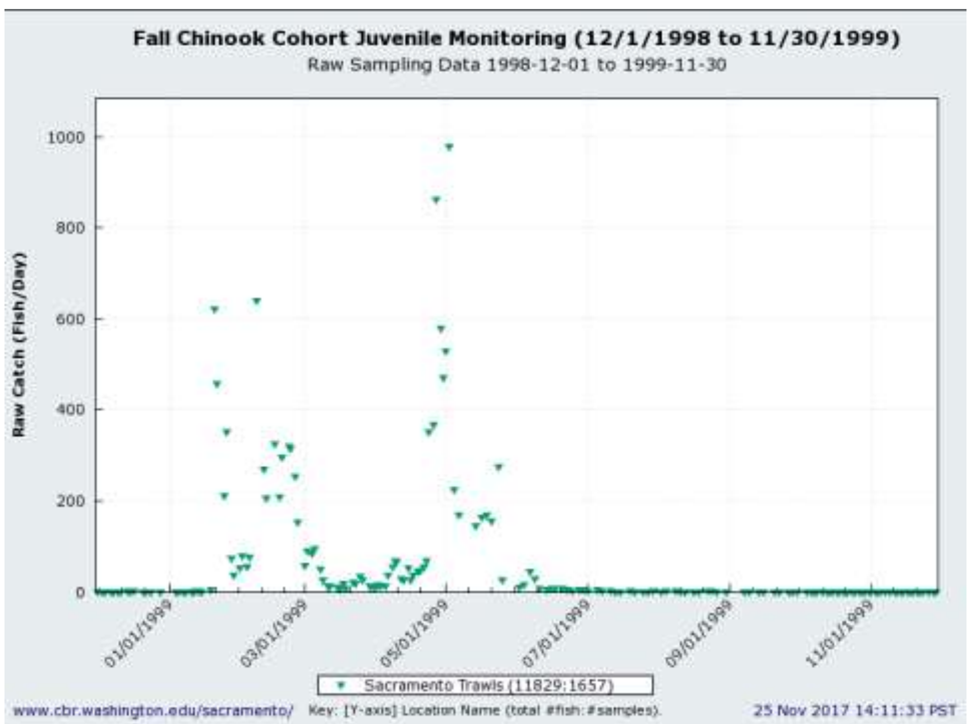
The most recent years of relatively normal salmon production on the Sacramento River were in the late 1990s and early 2000s. These years included the juveniles that migrated to the ocean and returned before the 2007 closure of the West Coast salmon fishing industry. The SacPas graphs of Sacramento trawl data from these years supports the 2008 DRERIP report conclusion that the majority of natural fall run emigrate as fry and not larger fingerlings. In the wet year of 1997, the majority of fall run migrated to the Delta in January through March.

The graphs below show Sacramento trawl data for fall run juveniles from WY 1997-98 (Exhibit PCFFA-140) and salvage at the SWP and CVP pumps (Exhibit PCFFA-141):

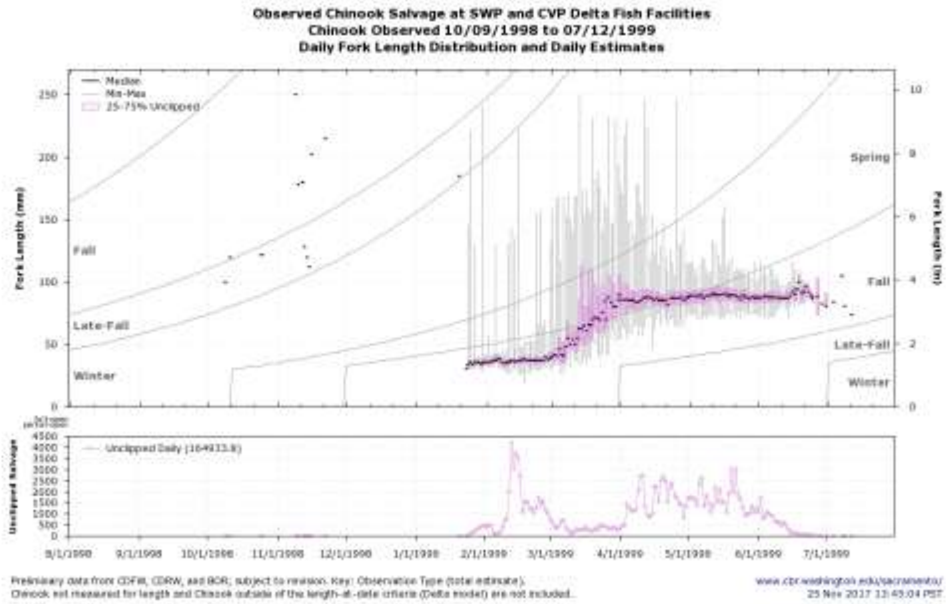




In 1998, there was a large pulse of fry migrating from late January to late March, shown in the Sacramento trawl (Exhibit PCFFA-142) and salvage at the pumps:



Salvage data from the SWP and CVP fish facilities shows that an estimated 165,000 unclipped Chinook were salvaged, with the peak in mid-February. Juveniles also emigrated almost continuously from February to mid-June (Exhibit PCFFA-143):



Based on the DRERIP report (Exhibit PCFFA-133) and Sacramento trawl and salvage data from before the 2007 shutdown of the West Coast salmon fishing industry, we believe it is clear NOAA’s estimate, based on only 2012-2016 Sacramento Trawl data, that only 3% of juvenile fall run Chinook salmon would be small enough to be entrained, should be revised to include a longer history.

More generally, salmon fishermen are concerned about the loss of history of productive years of juvenile Sacramento River Chinook salmon in NOAA’s analysis. We request that the Board require monthly and annual reporting of raw salvage numbers and length at date charts for salvage of Chinook salmon at all Delta diversions as a permit term.

The bypass criteria at the North Delta Diversions would provide little protection to migrating fall run juveniles. The bypass criteria only trigger when a majority of winter and spring run are migrating, and only when sufficient numbers of juveniles from those runs are caught at the new intakes. Even for salmon that migrate as fingerlings, the NMFS Biological opinion (Exhibit SWRCB-106) notes that adverse effects will occur. The NMFS BiOp states:

> [The National Marine Fisheries Service] expects that reduction in flow as a result of the PA will increase travel time for the majority of outmigrating smolts. This will result in an adverse effect to a high proportion of rearing and outmigrating fall-run Chinook juveniles. (p. 648.)

The NMFS BiOp also noted the increase in reverse flows in the months of February through May:

> In the north Delta, the velocity analysis indicated increased negative velocities under the PA during important fall-run Chinook salmon migratory months of February through May upstream and downstream of Georgiana Slough on the Sacramento River (BA Table 5.4-10 in Appendix C of this Opinion). Increased negative velocity can range up to 98% more during the month of March under the PA though most increases range between 7% to 30%. Increases in flow reversals would likely reduce the survival probability of outmigrating smolts by moving them back upstream, increasing their exposure to junctions that lead to migratory routes of lower survival, such as in Georgiana Slough. (Exhibit SWRCB-106, p. 602)

Based on these observations, it is clear that salmon life histories are dependent upon adequate flows and that we can reasonably expect that the proposed new North Delta diversions will have an unreasonably deleterious effect on fall and late fall run Chinook salmon on the Sacramento River.

III. BYPASS FLOW CRITERIA

PCFFA has long supported the establishment of adequate flow criteria for the Sacramento River and we believe that the Water Board has failed its responsibility to develop such criteria for the past seven years. Water Code 85086(c)(1) provided that:

> For the purpose of informing planning decisions for the Delta Plan and the Bay Delta Conservation Plan, the board shall, pursuant to its public trust obligations, develop new flow criteria for the Delta ecosystem necessary to protect public trust resources. In carrying out this section, the board shall review existing water quality objectives and use the best available scientific information. The flow criteria for the Delta ecosystem shall include the volume, quality, and timing of water necessary for the Delta ecosystem under different conditions. The flow criteria shall be developed in a public process by the board within nine months of the enactment of this division. The public process shall be in the form of an informational proceeding conducted pursuant to Article 3 (commencing with Section 649) of Chapter 1.5 of Division 3 of Title 23 of the California Code of Regulations, and shall provide an opportunity for all interested persons to participate. The flow criteria shall not be considered predecisional with regard to any subsequent board consideration of a permit, including any permit in connection with a final BDCP.

The State Water Resources Control Board held the Delta Flow Criteria informational hearing in 2010, and significant information was developed on the volume, quality, and timing of water necessary for Chinook salmon. Water Code 85086(c)(2) requires the Board to include those flow criteria in any order approving a change in point of diversion:

> Any order approving 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 shall include appropriate Delta flow criteria and shall be informed by the analysis conducted pursuant to this section. The flow criteria shall be subject to modification over time based on a science-based adaptive management program that integrates scientific and monitoring results, including the contribution of habitat and other conservation measures, into ongoing Delta water management.

PCFFA/IFR opposes approval of the WaterFix project. We believe that the proposed diversions are enormous and the fish screens have never been tested. However, PCFFA/IFR does support amending the permits of the State Water Project and Central Valley Project to provide flows sufficient to sustain salmon migration and rearing in the Delta. This is something that has been needed for decades. PCFFA/IFR therefore requests that the following flow criteria, or more protective criteria for other estuarine species, be made part of the permits for the State Water Project and Central Valley Project, regardless of whether the Board approves the WaterFix project or this change petition.

NMFS' Biological Opinion describes an "Unlimited Pulse Protection" scenario thusly:

> "The following operational framework serves as an example that is based on the recommended NDD RTO process (Marcinkevage and Kundargi 2016)…."
>
> - A fish pulse is defined as combined catch of Xp winter-run and spring-run sized Chinook salmon in a single day at specified locations.
> - Upon initiation of fish pulse, operations must reduce to low-level pumping.
> - Pumping may not exceed low-level pumping for the duration of fish pulse. However, additional pumping above low-level may be allowed as long as a minimum of 35,000 cfs bypass flow is maintained during the period of pulse protection. A fish pulse is considered over after X consecutive days with daily combined catch of winter- and spring run-sized Chinook salmon less than Xp at or just downstream of the new intakes.
> - Post-pulse bypass flow operations will be determined through initial operating studies evaluating the level of protection provided at various levels of pumping.
> - All subsequent pulses of winter- and spring-run Chinook salmon will be afforded the same level of protection as the first pulse.
> - Unlimited fish pulses are protected in any given year.
>
> (Exhibit SWRCB-106, p. 731-732.)

This is just an "operational framework." The triggers and amount of the bypass flows are not yet determined, and since the bypass flows are only triggered by the presence of two Evolutionarily Significant Units (ESUs) of Sacramento River Chinook salmon, they conflict with recommendations by DFW and environmental and fishing groups in the Delta flow criteria hearing held in 2010. Because the timing of these bypass flows is tied to the presence of two ESUs of Sacramento River Chinook, they are notably insufficient to protect fall and late fall run Chinook salmon, which provide public trust benefit to PCFFA members. The 2010 Delta Flow criteria report stated that flows for salmon would be met by higher flow requirements to protect other estuarine species. However, as of this date, the Board has not determined these additional flow requirements. The modifications would provide more adequate protection for migrating salmon and other species.

Adequate flow criteria must necessarily include adequate floodplain habitat for rearing juvenile salmon. Studies have shown that migrating salmon are not growing as expected while in the Delta. Miller *et al.* state,

> Although estuaries are known to provide rearing habitat for Chinook salmon (Reimers 1973, Healey 1991, Simenstad et al. 1982, Bottom et al. 2005, Volk et al. 2010), research in San Francisco Bay indicates that juvenile Chinook salmon may derive less benefit from estuarine residence than more northerly populations (MacFarlane & Norton 2002). During the 1997 emigration, juvenile Chinook salmon (68 to 110 mm FL) resided in the estuary for an average of 40 d and grew relatively slowly (mean = 0.18 mm d–1) (MacFarlane & Norton 2002). Overall, their mean condition declined as they migrated through San Francisco Bay until they reached adjacent coastal waters where their growth rates accelerated (MacFarlane & Norton 2002).
> (Exhibit PCFFA-135, p. 237)

The genetic study by Harvey et. al. of juvenile Chinook salvaged at the state and federal Delta pumps found that older juveniles being misclassified due to abnormal growth rates:

[E]mpirical fork lengths trends for all races failed to exhibit the constant apparent growth rates used to generate length-at-date size criteria. In fact, in at least half the years evaluated for each race, older juveniles did not exhibit any significant positive apparent growth, with significant negative fork length trends in several years. (Exhibit PCFFA-136, p. 1.)

Studies have shown that salmon grow better in floodplains. The picture below is from the UC Davis blog post, *Frolicking fat floodplain fish feeding furiously* by Carlson Jeffries.

(Exhibit PCFFA-144.) Jeffries' blog in turn cites his study, Jeffries, C., J. Opperman and P. Moyle (2008), "Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river," *Environmental Biology of Fishes* 83 (4): 449-458.[5]

For this reason, we support the recommendations of American Rivers, The Bay Institute, et. al. in the 2010 Delta flow criteria proceeding that the State Water Resources Control Board require Fremont Weir be notched to allow inundation of the Yolo bypass at 23,100 cfs (Exhibit PCFFA-145, p. 29-30.) These groups also recommended that storm inflows be bypassed to provide at least 35,000 cfs of flow at Verona for 1-4 months, so that the bypass may be inundated. Table 4 from p. 63 of the 2010 Delta Flow Criteria report (Exhibit SWRCB-25) is reproduced below:

Table 4. Inundation Thresholds for Floodplains and Side Channels at Various Locations Along the Sacramento River

Location	Stage (in feet)	Inundation Threshold (cfs)	Target Discharge (avg. cfs)	Gauge Location	Source
Freemont Weir					
Existing crest	33.5	56,000	63,000	Verona	USGS
Proposed notch	17.5	23,100	35,000	Verona	USGS
Sutter Bypass					
Tisdale weir	45.5	21,000		Colusa	NOAA; Feyrer
Tisdail with notch					
Lower Sutter Bypass	25	30,000	30,000	Verona	USGS
Upper Sacramento Meander belt side channels	Various	10,000	12,000	Red Bluff	USGS

[5] Available at http://www.springerlink.com/content/e873456118pjl537/

We also request that the Board enact American Rivers, TBI et. al.'s recommended flow target to provide Yolo bypass inundation, as bypass requirements for CVP and SWP reservoirs:

Table 4. Flow recommendations for floodplain inundation flows.

Floodplain Inundation Flow Targets

	Dec	Jan	Feb	March	April	May	Average c.f.s.	Days	MAF
Inundation Target Window									
Wet (80 - 100 percentile)							35,000	120	8.3
Normal wet (60 - 80 percentile)							32,500	90	5.8
Normal dry (40 - 60 percentile)							30,000	60	3.6
Dry (20 - 40 percentile)							27,500	30	1.6
Critica (0 - 20 percentile)							27,500	15	0.8

(Exhibit PCFFA-145, p. 32)

If the Board decides to perform a water supply cost analysis for this proposed permit term, and those water supply costs are found to be too large, we request that the Board evaluate the option recommended by DFW of sufficient flows to provide a minimum of 30 days of inundation of the Yolo bypass, with Fremont Weir notched to pass flows at 23,100 cfs.

In addition to the floodplain inundation criteria, we also request that the Board require that the SWP and CVP bypass storm flows sufficient to provide mean daily outflows at Rio Vista above 25,000 cfs from April 1 to June 30 in all years. This request is based on testimony by several witnesses in the 2010 Delta Flow criteria hearing. DFW testified:

> USFWS (1987) presented evidence that habitat alterations in the Delta limit salmon production primarily through reduced survival during the outmigrant (smolt) stage. These lower survivals are associated with decreases in the magnitude of flow through the estuary, increases in water temperature, and water project diversions in the Delta. The survival of marked hatchery smolts through the Sacramento Delta between Sacramento and Suisun Bay was found to be positively correlated to flow and negatively correlated to water temperature. Two independent measures of survival related Smolt survival increases with increasing Sacramento River flow at Rio Vista. Maximum survival was observed at or above 20,000 to 30,000 cfs.
>
> In addition to survival being higher with higher flows, Chinook salmon abundance was also found to be higher with greater river flow. The abundance of juveniles leaving the Delta at Chipps Island was found to be higher with higher mean daily flows at Rio Vista from April through June. The highest abundance leaving the Delta was observed when Rio Vista flows averaged above 20,000 cfs from April through June, the same level at which survival rates were maximum.

(Exhibit PCFFA-146, p. 1.)

PCFFA consultant Bill Kier testified that bypass flows of above 25,000 cfs were needed from April 1 through June 30, as inflow at Freeport and outflow at Rio Vista (Exhibit PCFFA-147, p. 7, as corrected by Exhibit PCFFA-148), and referred to the same 1987 study by USFWS. (Exhibit PCFFA-149.)

DFG also testified in the 2010 Delta flow criteria hearing:

> Thus, juvenile Chinook salmon appear to need increases in Sacramento River flow that correspond to flows in excess of 20,000 cfs at Wilkins Slough by November and with such peaks continuing past the first of the year.
>
> As discussed earlier, high levels of Chinook salmon smolt abundance and survival in the Delta are also associated with Sacramento River flow in excess of 20,000 cfs at Rio Vista (USFWS 1987). The monitoring and research being conducted independently at Knights Landing and in the Delta both indicate that flows in the lower Sacramento River and Delta on the order of 20,000 cfs and above are an important environmental threshold for Chinook salmon emigration. That is, flow levels of this magnitude are necessary to provide the continuum of conditions necessary to sustain emigration of juvenile Chinook salmon and enhance their survival throughout the lower Sacramento River and Delta system. The primary period of concern for late-fall, winter, and spring-run begins in fall, as described above, and continues through at least March. Flow needs for fall-run Chinook salmon continue through at least May in the lower Sacramento River and June in the Delta, the latter portion of this period including production releases of fall run from Central Valley anadromous hatcheries.

(Exhibit PCFFA-146, p. 7-8.)

Based on this testimony, we also request that the Board require that the CVP and SWP bypass sufficient storm flows from November through March to provide mean daily flows of *at least* 20,000 cfs inflow at Freeport and outflow at Rio Vista from November through February. We believe that requiring bypasses of sufficient storm flows should support beneficial uses of the Delta for salmon spawning, migration, and rearing.

//

//

//

//

//

//

//

IV. CONCLUSION

Based on this testimony, it is clear that the Water Board must rule against the change in point of diversion in order to protect the beneficial use of commercial salmon fishing, preserve the public trust, and minimize unreasonable impacts to fish and wildlife.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that I executed this declaration November 29, 2017 in San Francisco, California.

NOAH OPPENHEIM