Fish Abundance, Delta Flows and Water Exports
DFG-WRINT-8 (1992 SWRCB Hearings) Revisited

Prepared for the California Sportfishing Protection Alliance

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We participated in the preparation of exhibits and testified on behalf of the California Department of Fish and Game (DFG) in evidentiary hearings held by the State Water Resources Control Board (SWRCB) in 1992. These Exhibits and testimony demonstrated that many fish species in the Bay-Delta Estuary were in decline, and that they were adversely affected by water diversions and reduced flows. Based on the best science available, the exhibits and testimony also described alternatives for increased flow levels and reduced water exports that were needed to protect and restore fish populations to various levels of increased abundance. From this and other evidence, the SWRCB drafted Water Rights Decision 1630. This Decision would have set improved water quality and flow standards for the Estuary and new conditions on water rights permits. However, despite substantial evidence of need to fix the “broken Delta ecosystem”, this draft Decision was never implemented. Instead, a committee composed of project operators, stakeholders, and resource biologists, with various names (CalFed Ops Group was one), met and made recommendations on project operations intended to reduce or eliminate the impacts on the Delta and the costs of implementing the action. The recommendations were then presented to the project managers for consideration, and led to the 1994 Bay-Delta Accord and the 1995 Water Quality Control Plan. The 1995 Water Quality Control Plan was reviewed and revised, but not substantively, in 2006. This process has not yielded the improved flows or export reductions necessary to “fix the ecosystem.”

Over the period in question (1992 to date), the committee followed rules developed from a variety of sources. These included D1641 standards, gaming simulations for the Environmental Water Account (EWA), and the Biological Opinions (BO’s) for delta smelt, winter and spring Run Chinook Salmon, and steelhead rainbow trout.

During this period of time, the committee was a water project sponsored entity, a CalFed sponsored entity, and most recently a Federal BO driven entity. Today (as we prepare this Exhibit) the water projects and their customers are using their political influence and the Courts to maintain the export of water from the Estuary.

WRINT-DFG-8 (DFG exhibit from 1992 hearing) stated that the environmental costs of no action were likely to be high. This has proven to be the case. In recent years, many of the Estuary's fish populations have been at record low levels, and several native fishes (delta smelt, longfin smelt, winter- and spring-run Chinook salmon, central valley steelhead and green sturgeon) have been listed under the State and Federal endangered species acts. In addition, fall-run Chinook salmon and Pacific herring abundance has been of particular concern recently, as commercial and sport fisheries have been closed for the past two years for Chinook salmon and this year's Pacific herring commercial fishery in San Francisco Bay was closed for the first time ever.

Striped bass and delta smelt provide good examples of drastic declines in fish abundance. During the period from 1959 to 1991, the DFG summer tow net survey index (DFG Bay-Delta web site) of young striped bass abundance ranged from 4.3 to 117.2. The mean index for this period is 68.3. Since 1992, it has ranged from 0.3 to 23.4. The mean for this period is only 2.1 and the index has not exceeded 1.5 since 2003.

The summer index of delta smelt abundance ranged from 1.8 to 62.5 before 1992. The mean for this period is 14.7. Since 1992, the index has ranged from 0.3 to 13.0 with a mean of 4.5. Since 2005, the index has not exceeded 0.6.

WRINT-DFG-8 described, in detail, alternatives for flow and water export levels that would yield a range in population levels of Delta fishes. These alternatives were based on long-term fish monitoring programs and historic relationships between fish abundance and outflow and amounts of water exported. Much emphasis was placed on striped bass. It supports a recreational fishery of major economic importance and also is an important indicator for many other freshwater and estuarine fish species. The early life of striped bass is similar to that of the delta smelt and several other fish species in the Estuary in that the larvae and young tend to be transported by river currents and tidal flows – in essence, they go with the flow. Thus, when outflows are low and water exports are high, many young fish and their planktonic food supply are entrained in water exported from the southern Delta and are lost from the Estuary. When outflows are high more young fish are transported west to Suisun Bay where they are not entrained and the shallow habitat tends to produce more food items (phytoplankton, zooplankton, and detritus) which in turn increase fish growth and survival.

Salmon. WRINT-DFG-8 has recommendations intended to minimize entrainment of Chinook salmon in water exports. These recommendations cover all four runs of Chinook salmon. For the Sacramento River runs, the recommendations include Delta Cross Channel and Georgiana Slough closures on the Sacramento River at Walnut Grove, river flow levels at Rio Vista, prevention of reverse flows in the San Joaquin River at Jersey Point, and water exports at reduced levels. Additionally, a barrier is recommended at the upper

end of Old River to benefit the San Joaquin fall Chinook salmon run. Three alternatives are presented with degrees of protection dependent on time periods, flow amounts, and water export levels. We refer you to WRINT-DFG-8 for details. Since the water projects operate in basically the same manner now as in 1992, we see no need to change the recommendations in WRINT-DFG-8.

Striped Bass. Flow and export alternatives for striped bass are specified in WRINT-DFG-8 tables 1-6. We refer you to that exhibit for complete details, caveats, and explanation of methods. However, below, we have reproduced Table 2 from WRINT-DFG-8 to provide an understanding of how striped bass abundance was estimated to vary under a range of outflow and exports for various water year types (critically dry, dry, below normal, above normal, and wet). Alternative A estimates abundance based on conditions similar to those provided by a 1995 level of development operations study. Alternatives B and C are examples of flow and export scenarios that would increase adult striped bass abundance to 1 million and 1.7 million fish with spring outflows increased 25 and 50 percent, respectively. (*The abundance estimations assume that recruitment to the adult population -- fish 3 years and older-- is proportional to the abundance of young bass 3 years earlier. That assumption apparently is not entirely valid; recently some year classes that had very low abundance when young provided better than expected recruitment suggesting that survival after the first few months is greater for some of the weakest year classes. Nevertheless, the most recent estimate (for 2007) of adult striped bass abundance is approximately 600,000 fish (DFG Bay-Delta web site) – the lowest abundance since DFG began making adult striped bass abundance estimates in 1969.)*

Table 2. Mean Delta Outflows and Exports Required to Maintain Populations of 600,000 (Alternative A), 1 Million (Alternative B), or 1.7 Million (Alternative C) Adul Striped Bass

Year Type	Apr-Jul Outflow (cfs)	Apr-Jul Exports (cfs)	Aug-Dec Outflow (cfs)	Aug-Mar Exports (cfs)
Alternative A - 600,000 Adult Bass				
C	4,500	2,600	3,700	8,600
D	7,200	4,500	8,000	9,800
BN	9,600	6,000	10,200	10,000
AN	15,300	7,400	11,000	10,500
W	29,000	8,800	14,300	11,200
Alternative B - 1 Million Adult Bass				
C	5,600	1,600	3,700	5,000
D	9,000	3,400	8,000	6,000
BN	12,000	4,400	10,200	6,500
AN	19,200	5,400	11,000	7,100
W	36,200	6,400	14,300	7,900
Alternative C - 1.7 Million Adult Bass				
C	6,700	500	3,700	1,100
D	10,800	1,000	8,000	2,900
BN	14,400	1,500	10,200	3,700
AN	23,000	2,000	11,000	4,600
W	43,000	3,000	14,300	5,100

Estuarine Fish. Regarding requirements of native estuarine species, DFG staff formulated a set of alternatives based on abundance – outflow relationships for longfin smelt, bay shrimp, starry flounder, and Sacramento splittail. These alternatives are depicted in WRINT-DFG-8 tables 8-10. The outflows from Table 8 are shown below.

(*In Table 8, LOD = Level of Development. Alternative A and B critical year flows are identical because critical year flows were also increased by 25 percent in Alternative A. They were increased because projected critical year flows in the operation study were only 70 to 80 percent of actual flows in the 1987-1991 drought. This difference led to lower estimates of abundance than provided by the actual flows.)*

Table 8. Target Mean Monthly Flows for Three Alternatives Based on Data from A) DWR's 1995 LOD Operations, B) 1995 LOD + 25% Increase, and C) LOD + 50% Increase.

Alternative A - Based on 1995 LOD Operations Study

Year Type	Feb	Mar	Apr	May	Jun
C	8,000	7,200	6,500	5,700	5,200
D	15,400	15,900	8,400	7,600	6,300
BN	34,400	21,100	11,500	10,700	8,900
AN	61,100	60,500	23,300	16,100	13,400
W	93,500	74,300	49,400	33,400	22,500

Alternative B - Based on 1995 LOD + 25% Increase

Year Type	Feb	Mar	Apr	May	Jun
C	8,000	7,200	6,500	5,700	5,200
D	19,200	19,900	10,500	9,500	7,900
BN	43,000	26,300	14,400	13,300	11,100
AN	76,300	75,600	29,200	20,100	16,700
W	95,000	89,000	61,700	41,700	28,100

Alternative C - Based on 1995 LOD + 50% Increase

Year Type	Feb	Mar	Apr	May	Jun
C	9,600	8,600	7,800	6,900	6,200
D	23,100	23,900	12,600	11,400	9,500
BN	51,600	31,600	17,300	16,000	13,300
AN	91,600	90,000	35,000	24,100	20,100
W	95,000	89,000	74,100	50,000	33,800

The estimated increases in abundance for longfin smelt, bay shrimp, starry flounder and splittail using Alternative B would average about 28,19,11, and 13 percent respectively, while Alternative C increases would average about 58, 37, 23, and 21 percent.

Delta Smelt. DFG did not offer specific standards for the protection of delta smelt in the 1992 hearings because of uncertainty about quantitative relationships between their abundance and likely controlling factors. However, WRINT-DFG-8 indicates that delta smelt are likely adversely affected by reduced Delta outflows and increased water exports. Like striped bass, young delta smelt are vulnerable to being drawn to the south Delta export facilities, and they are probably more

vulnerable to mortality because of their sensitivity to handling which occurs during the screening and trucking process. Therefore, we are confident that the best Alternatives for striped bass would provide a major benefit for delta smelt, and the best Alternatives for estuarine fishes would also provide significant benefits for delta smelt.

Other Factors. Other factors including water pollution, changing ocean conditions, increased water diversions upstream from the Delta, and recent invasions of the Asian clam, mitten crabs, other invertebrates and several fish species may inhibit ecosystem restoration. However, various DFG surveys and published reports provide excellent documentation of declining fish populations as water exports increased in the 1970s and 1980s -- before most of these other changes occurred. Thus, while other factors may be contributing to the degradation of the Estuary, there is no question that water exports and reduced flows are playing a major role.

Recommendation. During recent years water exports have continued to entrain Delta fishes and significantly reduce outflows. In response, abundance of many fish (and their food organisms) has been at record or near record lows. The Delta ecosystem is still “broken.” Under it’s public trust responsibilities, the primary goal of the SWRCB should be to restore a healthy, viable ecosystem in the Sacramento-San Joaquin Estuary. In our opinion, attainment of this goal requires adoption of standards that require greater outflows from spring through fall and reduced water exports. Significant restoration will likely require outflows and exports similar to those shown in the WRINT-DFG-8 Alternative Cs for Chinook salmon, striped bass and estuarine fish. Although 18 years have passed since we worked on WRINT-DFG-8, the recent trends in fish populations are reasonably consistent with our projections at that time, and we believe the analysis in WRINT-DFG-8 is still appropriate.