MICHAEL R. SHERWOOD, State Bar No. 63702
ANDREA A. TREECE, State Bar No. 237639
Earthjustice
426 17th Street, 5th Floor
Oakland, CA 94612
atreece@earthjustice.org
Telephone: 510/550-6725
Facsimile: 510/550-6749

TRENT W. ORR, State Bar No. 077656
953 Clayton Street, #5
San Francisco, CA 94117
torr@earthjustice.org
Telephone: 415/665-2185
Facsimile: 415/665-2592

Attorneys for Plaintiffs

HAMILTON CANDEE, State Bar No. 111376
KATHERINE POOLE, State Bar No. 195010
Natural Resources Defense Council
111 Sutter St., 20th Floor
San Francisco, CA 94104
hcandee@nrdc.org; kpoole@nrdc.org
Telephone: 415/875-6100
Facsimile: 415/875-6161

Attorneys for Plaintiff NRDC

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF CALIFORNIA

NATURAL RESOURCES DEFENSE COUNCIL, *et al.* Plaintiffs, v. DIRK KEMPTHORNE, Secretary, U.S. Department of the Interior, *et al.* Defendants. SAN LUIS & DELTA-MENDOTA WATER AUTHORITY and WESTLANDS WATER DISTRICT; CALIFORNIA FARM BUREAU FEDERATION; GLENN-COLUSA IRRIGATION DISTRICT, *et al.*; CALIFORNIA DEPARTMENT OF WATER RESOURCES, and STATE WATER CONTRACTORS, Defendant-Intervenors.	Case No. 05-CV-01207 OWW TAG DECLARATION OF CHRISTINA SWANSON IN SUPPORT OF PLAINTIFFS' REPLY ON REMEDIES Date: August 21, 2007 Time: 9:00 a.m. Courtroom: 3 Judge: Hon. Oliver W. Wanger

I, Christina Swanson, declare as follows:

1. I have reviewed the declarations of Cay C. Goude, Charles Hanson, Bruce F. Oppenheim, Stephen Ford, Curtis C. Spencer, John Leahigh, Ronald Milligan, William Miller, Jerry Johns, and Bryan Manly filed in the remedy proceeding in this action. This declaration responds to their declarations and provides further analysis supplemental to my July 23, 2007 declaration in this case ("7/23/07 Swanson Dec."). I will first provide a set of general comments on the approach of the defendants' and defendant-intervenors' experts (collectively referred to as "defendants' experts"); then I will describe a refinement of the interim protection measures I recommend be implemented; and finally, I will specifically respond to the declarations of several of the defendants' experts.

General Response Comments ¶

2. Before providing comments on the content of individual declarations, the following section describes several general responses to the collective submissions. Based on my review, four overarching issues are apparent.

3. First, both the federal and state agencies responsible for protecting and managing delta smelt and its critical habitat and the defendant-intervener contractors who benefit from water exported from the fish's habitat appear to have failed to recognize the extreme seriousness of the present status of the species. Empirical evidence from all four independent surveys conducted by the California Department of Fish and Game (CDFG) show that delta smelt have been at record low numbers for the past three consecutive years (7/23/07 Swanson Dec., Table 1). Population viability analyses conducted by Bennett (2005) showed that there was a 26-30% risk of extinction in the next two decades. The scientific evidence (including peer-reviewed published research) that water management operations in the delta smelt's critical habitat are a major contributor the species' decline has grown exponentially in the past several years. All of this evidence indicates, overwhelmingly, that continuation of past management and protection approaches is insufficient to avoid jeopardizing the continued existence of the species and to avoid adversely modifying the critical habitat it needs for survival and recovery.

4. The defense experts' declarations attempt to argue, instead, that the condition of the species has improved (Hanson), that water project operations do not affect the species (Miller, Manly); that water management operations similar to (or more harmful than) those implemented during the past several years will provide sufficient protection for the species (Johns, Hanson); that, even though delta smelt numbers are now below the detection limits of key monitoring surveys, the results of those surveys will be sufficient to guide implementation of protection actions (Goude, Ford, Johns, Hanson); and that, because the recent record low delta smelt abundance data fall below the regression line that reliably predicted delta smelt abundance in relation to environmental conditions for the previous eighteen years, no habitat protection action is warranted (Ford). Other declarations describe elaborate (but poorly designed) analytical attempts to try to count the number of young delta smelt present in the estuary (Hanson) and to determine when the young fish were lethally entrained into the SWP's Clifton Court Forebay last summer (Ford, Spencer). Given that the objective of this proceeding is to identify interim protections needed by the species until a long-term biological opinion is completed, these efforts are misplaced and uninformative, diverting attention from the serious shortcomings in past and present protection of the delta smelt and its critical habitat.

5. Second, following the failure of the defendants to address the known adverse modifications to delta smelt critical habitat caused by water project operations in their biological opinion, it is extraordinary that none of the interim protection programs proposed by the defendants' experts include measures to address impacts to critical habitat. Defendant experts' proposals are instead largely focused on the impacts of entrainment in the federal and state pumps. Peer-reviewed, published scientific research conducted by CDWR scientists has shown that reduced freshwater outflows during the fall have significant adverse impacts on delta smelt abundance and habitat quality and that these harmful conditions have worsened in recent years. The defendants' experts fail to address water project operations that are known to appreciably diminish the value of critical habitat for either the species' survival and for its recovery.

6. Third, some aspects of the interim protection regimes proposed by defendants' experts will result in conditions that are actually worse than those observed in delta smelt critical habitat in recent years, during the period in which the delta smelt population collapsed. For

example, based on actual flow data from the Delta, the level of net westerly flows on the lower San Joaquin River that Dr. Hanson has proposed in his declaration has, in past years, frequently corresponded to reverse flows on Old and Middle Rivers in excess of -8,000 cfs. This level of negative flow on the Old and Middle Rivers is known to correspond to high take of delta smelt at the export facilities and is actually more harmful than average reverse flow conditions measured during the most of the 2000s. In addition, almost all of the protection actions proposed by defendants' experts are based on a single research result, the statistical relationship between salvage of adult delta smelt and combined Old and Middle River flows. We know considerably more about the effects of water project operations on delta smelt and their habitat than this. Effective protection of delta smelt and its critical habitat will require a more integrated approach that synthesizes different research results, incorporating information on salvage, survival, population abundance and habitat quality.

7. Finally, both the USFWS Delta Smelt Action Matrix for Water Year 2008 (proposed by Ms. Goude) and the alternative interim protections proposed by defendant-interveners rely almost exclusively on existing monitoring programs to trigger implementation of protection actions and to determine the level of protection to be provided. I do not believe that we have sufficient resolution or precision in either our existing monitoring capabilities or our quantitative understanding of relationships between environmental, operational and biological variables to effectively apply such an approach. Delta smelt numbers have fallen to such low levels that they are below the detection limits of at least two key CDFG surveys (*i.e.*, the 20-mm survey and the Summer Townet survey), and there is no monitoring to detect the presence critical early life stages of delta smelt (*i.e.*, fish smaller than 20 mm in length) at the water export facilities. Misplaced confidence in these unreliable results to determine the entrainment risk of delta smelt could delay or preclude the implementation of needed protections and/or reduce the magnitude of the protective actions. Given the present critically imperiled status of delta smelt, this approach will be insufficiently protective to avoid jeopardizing the species or adversely modifying their critical habitat

Clarifications and Additions to the Plaintiffs' Recommended Interim Protection Actions for Delta Smelt

8. The interim protection actions contained in my earlier declaration are, based on my thorough review of the available science, necessary to avoid jeopardy to the delta smelt from water project operations and to prevent adverse modification of its critical habitat by water project operations, which would otherwise appreciably diminish the value of critical habitat for either the species' survival and for its recovery. In this declaration, I provide some minor clarifications and additions to some aspects of some of the Plaintiffs' recommended protection actions. These clarifications and additions are intended to address practical considerations relating to water project operational capabilities and compliance methods. The clarifications are: (a) for Action 4, to identify the time period over which increases in Sacramento River flows function to trigger implementation of a protective action to eliminate reverse flows on Old and Middle River; and (b) for Actions 4, 5 and 7, to express Old and Middle River flow objectives as a range centered on the specific flow objective recommended for protection of delta smelt. These minor changes have no effect on the overall level of protection to delta smelt and their habitat provided by the recommended actions. *See* Appendix.

Comments on the Reply Declaration of Cay C. Goude (Docket No. 433-4)

9. Ms. Goude states that the interim protections proposed by the USFWS are "expected to provide" only the "minimum … necessary to protect delta smelt" from adverse effects of CVP and SWP water management operations. Goude Reply Dec., ¶ 9. The limited protections outlined in the USFWS proposal are designed to reduce entrainment by project pumps. However, past, current and future water project operations, even after full implementation of the limited protections outlined in the USFWS proposal, also have adverse impacts on delta smelt habitat, appreciably diminishing its value to the species for survival and recovery. The USFWS' failure to propose any interim protection actions to address adverse impacts to delta smelt critical habitat ignores available science, including peer-reviewed published research conducted by CDWR scientists that directly addresses this issue (i.e., Feyrer *et al*. 2007).

10. Ms. Goude's declaration provides additional support and rationale for the five interim protection actions proposed by the USFWS, including reference to analyses conducted by Dr. Bryan Manly (consultant to the San Luis Delta Mendota Water Authority and Westlands Water District) and Dr. Michael Chotkowski (U. S. Bureau of Reclamation) that confirm the statistically significant effect of water project operations on delta smelt abundance. Goude Reply Dec., ¶ 2. These statistical analyses, along with studies and analyses conducted by Dr. Peter Smith and Dr. Bennett, have informed the development of the limited protection actions proposed by the USFWS, but are not accurately reflected in the proposals of other defendant experts.

11. Ms Goude also notes that the adverse effects of water project operations are greater in dry years than in wetter years. She states that export-related losses of delta smelt are "more likely to occur in drier years," and that with delta smelt abundance at such low levels, "it is reasonable to assume that increased losses will have an adverse effect on the delta smelt population." Goude Reply Dec., ¶ 2. The delta smelt population is currently at critically low levels. As evidenced by their chronic low abundance during the past few years despite favorable hydrological conditions (*i.e.*, relatively "wet" conditions in 2005 and 2006), the resilience of the species (*i.e.*, its ability to respond to improved environmental conditions with increases in population size) is extremely low. Yet, despite the fact that water year 2007 was a "dry" year in the Sacramento basin and a "critical" year in the San Joaquin Basin (*see* Leahigh Reply Dec., ¶ 13 and Exhibits A and B) and that no forecast for 2008 can be made yet, there is no indication that the recent unfavorable conditions, or their effects on delta smelt survival and critical habitat, were considered by USFWS in the design of its proposed interim protections or in Ms. Goude's conclusion that "minimum" protection would be sufficient for this imperiled species in the coming year.

12. Ms. Goude fails to address two other serious flaws with the USFWS' proposed interim protections. First, their protection actions to protect young fish from lethal entrainment still rely on CDFG survey and CVP and SWP salvage data to "infer the risk of entrainment" and to subsequently determine the magnitude of the protective action to be implemented despite that fact that USFWS clearly recognizes the limitations of current survey programs to accurately detect the presence and determine the distribution of larval delta smelt. Goude Reply Dec., ¶6. Second, Ms.

Goude offers no clarification of the decision process for implementing the USFWS' Actions 3 or 4, which the USFWS proposes to leave to the Water Operations Management Team (WOMT). 7/3/07 Goude Dec., Attachment A to Exhibit A, #4 (Docket No. 396-5). She also provides no response to Plaintiffs' recommendation for monitoring for larval and small juvenile delta smelt at the export facilities, a program that is essential to accurately assess entrainment risk and to determine the timing and magnitude of the direct impacts of CVP and SWP export operations on this critical life stage of the delta smelt.

Comments on the Declaration of Charles Hanson (Docket No. 415)

13. Dr. Hanson's declaration describes his method for and results of estimating delta smelt population abundance using data from the 2007 California Department of Fish and Game (CDFG) 20-mm survey. As far as I am aware, this type of analysis and population estimate has never been done with data from the 20-mm survey (in paragraph 10 of his declaration, Dr. Hanson mentions but does not fully cite or attach an analysis conducted by Sitts that produced a different result; without additional information it is impossible for me to evaluate or comment on this analysis). CDFG surveys that monitor delta smelt are all designed to assess fish distribution and relative abundance,[1] and the use of these surveys to estimate total population size is fraught with uncertainty. The utility of any numeric results from this approach is largely limited to comparisons over multiple years rather than meaningful estimates of the number of individual delta smelt present in the estuary at any time (as reported by Bennett 2005, in the only published, peer-reviewed description of this type of population estimation exercise). Dr. Hanson does not use his method to attempt to evaluate the trend in the total or relative size of the delta smelt population over the past several years, however, but instead offers only an estimate for a part of one year, thereby obscuring the sharp population drop in the past years found in every survey.

14. A review of the key assumptions identified by Dr. Hanson as the basis for his calculations casts further doubt on the validity of his conclusions. Independent peer review of an

[1] For example, according to the CDFG website description, the 20-mm survey is designed to provide information on "postlarval-juvenile delta smelt distribution and relative abundance" (website: http://www.delta.dfg.ca.gov/data/20mm/description.asp).

earlier version of Dr. Hanson's delta smelt population abundance estimation method conducted by Dr. Miller and others stated that "all of their assumptions are unsupported by the evidence and would tend to produce a high estimate of delta smelt population size." *See* Exhibit 1 (USGS 2003). For example, the assumption that delta smelt are uniformly distributed within the habitat (or even some subsection of their habitat as Dr. Hanson arbitrarily defined using "grid sections") at the same density that they are collected at the survey sample site, has been repeatedly shown to be incorrect in peer-reviewed, published scientific research (Moyle *et al*. 1992; Aasen 1999; Bennett *et al*. 2002; Bennett 2005). Delta smelt distribution within their habitat varies vertically (*e.g.*, delta smelt are rarely found in water deeper than 3.5 meters; Moyle *et al*. 1992), laterally (*e.g.*, Aasen 1999 found that delta smelt densities were significantly different between sampling locations in Honker Bay, Sherman Island and the San Joaquin River channel), and with the tides (*e.g.*, Aasen 1999 found that delta smelt densities at specific locations were significantly different between flood and ebb tide conditions). Even cursory review of past and recent CDFG 20-mm survey data show that delta smelt are unevenly distributed within the estuary. For example, the single survey used by Dr. Hanson to estimate that the delta smelt population numbered 1.8 million fish showed that, within the area identified as grid section A4, delta smelt density (measured as catch per unit effort, or CPUE) at two sampling stations (stations 706 and 707) differed by a factor of ten. *See* Exhibit 2 (DFG 20-mm survey, survey 9). Thus, even the minimal data Dr. Hanson used indicates that smelt distribution is not uniform and is contrary to his explicitly stated assumption. A second assumption made by Dr. Hanson, that CDFG sampling effectively collects a representative sample of delta smelt during each survey and that sampling only the upper portion of the water column is representative of delta smelt densities throughout the water column, is also clearly invalid. As described above, delta smelt distribution and density vary significantly with depth, with few delta smelt collected in water deeper than that typically sampled by CDFG nets; extrapolating densities of delta smelt measured near the surface to the volume of deeper water where delta smelt rarely occur would overestimate delta smelt numbers.

15. Dr. Hanson's use of 2007 CDFG 20-mm survey data for estimating delta smelt population abundance is particularly problematic for two reasons. First, according to Grimaldo *et*

al. (1998), throughout the spring and early summer, older and larger juvenile delta smelt are distributed further downstream than younger, smaller fish. Because the efficiency of the CDFG 20-mm survey's sampling gear increases as fish size increases (up to fish sizes of approximately 40 mm in length), the accuracy of fish density data derived from catch data at different stations (from which Dr. Hanson's population estimates were calculated) will vary geographically, adding larger amounts of error into any calculation of fish population numbers from this survey compared to the other CDFG surveys that sample delta smelt. Second, population estimates based on larval and juvenile life stages have extremely limited utility for assessing either population status or extinction risk because mortality rates between the larval, juvenile and adult life stages of fishes are typically high. As for most fish species, many more delta smelt eggs and larvae are produced than will survive through the juvenile life stage and then on to adulthood, reproduction and the production of the next generation of the species. As an example, using estimates of population size reported by Bennett (2005) for juvenile delta smelt from the CDFG Summer Townet survey (TNS) and for adult delta smelt from the CDFG Fall Midwater Trawl survey (FMWT) conducted a few months later, the percentage of young delta smelt surveyed by TNS that survive to be collected by the FMWT is approximately 4% to 25%.

16. Dr. Hanson's interpretation of his population estimates – and in particular his conclusion that the 20-mm survey data "show a substantial increase in delta smelt abundance occurring during the survey period from mid-June though early July" (Hanson Dec., ¶10) – rests on a serious analytic error. The higher numbers of juvenile delta smelt collected in the late June and July 20-mm surveys (Hanson Dec., Exhibits 4 and 5) do not reflect a sudden and dramatic increase in the delta smelt population, as Dr. Hanson suggests, but rather the customary increase in size of the growing juvenile delta smelt being collected in the surveys during this period and the resultant increasing efficiency of the 20-mm survey sampling gear in capturing them. This pattern of increasing catch numbers for delta smelt as the CDFG 20-mm survey progresses through the season and the young fish "recruit to the net" (*i.e.*, become more likely to be caught based on their

increasing size) has been observed in all years in which the 20-mm survey has been conducted, as shown in Table 1.[2]

17. What Dr. Hanson's analysis ignores is that, as shown in Table 1, the numbers of delta smelt collected by the sequential 20-mm surveys in 2007 were consistently and substantially lower than the numbers of delta smelt collected in the comparable surveys during the previous year (2006), during all of the 2000s, and in fact during the entire history of the survey. The numbers of larval and juvenile delta smelt collected in the estuary in 2007 using sampling methods identical to those used in previous years were lower than in all previous years that the survey was conducted.

[2] A true "increase in delta smelt abundance" would mean that the total number of individual fish present in the estuary was greater in July than in June, which could only be the result of more delta smelt spawning in June. Based on published peer-reviewed scientific research on the timing and required environmental conditions for delta smelt spawning, there are several reasons why this cannot be the case. First, by June, water temperatures in most areas of the Delta where delta smelt are known to spawn were warmer than the 12 to 18 degrees centigrade spawning temperature range for the species. Second, the smallest fish collected by the June surveys were 12 to 15 mm in length, compared to 5 to 6 mm for newly hatched delta smelt larvae. And finally, most of the young delta smelt collected by the survey were in the western Delta and confluence area, well downstream of known spawning areas.

Table 1. The total cumulative number of larval and juvenile delta smelt collected by sequential surveys of the CDFG 20-mm survey from 1995 to 2007 (beginning with survey 5, which is typically completed in early May, through survey 9, which is usually the final survey conducted in July). Results for the 2007 20-mm surveys are also shown expressed as the percentage of the numbers of young delta smelt collected by the same survey(s) in the previous year (2006) and as the percentage of the average numbers of fish collected for the same surveys during the previous five and ten year periods. Data sources: CDFG 20-mm survey website, 5/14/07 DSWG notes (Exhibit C to 7/23/07 Swanson Dec.), and California Department of Fish and Game.

Year	**Total cumulative number of delta smelt collected through completion of each sequential 20-mm survey**				
	Survey 5 (May)	Survey 6 (late May-early June)	Survey 7 (June)	Survey 8 (late June-early July)	Survey 9 (July)
1995	232	343	472	598	Not conducted
1996	2504	2889	3192	3413	Not conducted
1997	1229	1582	1764	1807	1850
1998	346	454	536	587	661
1999	1262	1733	2066	2231	2558[a]
2000	616	906	2120	2469	3342[b]
2001	301	501	925	1020	4917[c]
2002	332	382	470	621	Not conducted
2003	188	320	528	621	Not conducted
2004	444	563	608	651	Not conducted
2005	261	477	569	720	791
2006[d]	326	690	930	1084	1190
2007[d]	25	31	37	98	137
2007 as % of 2006	**8%**	**4.5%**	**4%**	**9%**	**12%**
2007 as % of 5 yr average (2002-2006)	**8%**	**6%**	**6%**	**13%**	**14%**[e]
2007 as % of previous 10 year average (1997-2006)	**5%**	**4%**	**4%**	**8%**	**12%**[f]

[a] Total cumulative number of delta smelt collected after 11 surveys.
[b] Total cumulative number of delta smelt collected after 12 surveys.
[c] Total cumulative number of delta smelt collected after 9 surveys but with three additional sampling stations added to several of the surveys.
[d] CDFG reports that final data QA/QC for 2006 and 2007 has not been completed.
[e] 2007 as % of 2005-2006 average.
[f] 2007 as % of 1997, 1998, 2005 and 2006.

18. Despite the consistent 20-mm survey results indicating that larval and juvenile delta smelt numbers were substantially lower than those measured by the comparable 20-mm surveys in 2006 and all previous years, the recently released 2007 Summer Townet abundance index for delta smelt is 0.4, identical to the 2006 value and essentially indistinguishable from the record low abundance index of 0.3 measured in 2005. This abundance value is the second lowest ever measured for the species during the nearly 50 years that this survey has been conducted and the third consecutive year of record low abundance. It indicates no improvement in the delta smelt population

from the record low levels measured by every CDFG survey during the past three to four years. 7/23/07 Swanson Dec., Table 1. In addition, for the same reason that "the ability of the [20-mm] survey to adequately sample for delta smelt is questionable" (Exhibit R to 7/23/07 Swanson Dec. (addendum to 6/11/07 DSWG notes)), the ability of the TNS survey to detect moderate changes in relative abundance in the recent years is similarly diminished. Clearly, Dr. Hanson has provided no basis to conclude that "the 2007 delta smelt cohort will be more resistant and resilient to various factors affecting population dynamics." Hanson Dec., ¶11. In fact, unless mortality rates of juvenile delta smelt between now and this coming fall, winter and spring are substantially reduced compared to mortality rates in previous years, these abundance results offer no indication that they will "contribute to higher abundance of delta smelt in the fall midwater trawl survey and contribute to the adults spawning population next spring," as claimed by Dr. Hanson (¶ 14). In contrast, the status of delta smelt remains the same (if not worse) as described by the DSWG earlier this year, "critically imperiled" and in urgent need of "emergency" protections. Exhibit D to 7/23/07 Swanson Dec. (5/15/07 DSWG briefing statement).

19. Informed by his erroneous conclusion that the current status of delta smelt is not as bad as reported by the DSWG scientists, state and federal water project and fisheries agencies, independent fisheries biologists including myself and Dr. Moyle (see, *e.g.*, Exhibits A and B to 7/23/07 Swanson Dec.), and the results of all CDFG monitoring surveys, Dr. Hanson has suggested revisions to the USFWS Delta Smelt Action Matrix for Water Year 2008. These revisions will (1) reduce the likelihood that the limited seasonal protections recommended by the USFWS will be triggered, (2) delay implementation of protection actions, and (3) reduce the magnitude of the recommended operational changes intended to prevent harm to the species. Dr. Hanson offers no actions to address the adverse effects of water project operations that continue to appreciably diminish the value of delta smelt critical habitat for the species' survival and recovery. Dr. Hanson's proposals for changes to the USFWS Delta Smelt Action Matrix will not protect the delta smelt from jeopardy or prevent further adverse modification of their critical habitat for the following reasons:

a) Dr. Hanson's "Tier 1" protection is to maintain "a positive net westerly flow of water within the lower San Joaquin River" from December 1 through June 30. Dr. Hanson provides no

evidence other than a qualitative description of particle tracking model exercises conducted using unknown flow and operational conditions to support his claim that this action will benefit delta smelt. Particle tracking modeling can be a useful tool when used appropriately, but extrapolation of results to infer or predict the distribution and movement of fishes is uncertain, particularly for fish capable of active swimming such as adult delta smelt. The results must be interpreted very cautiously and in the context of available information on the life history and behavior of the species in question. Dr. Hanson's hypothesis that net westerly flows on the lower San Joaquin River will prevent delta smelt from entering the central and southern Delta and cause the geographic distribution of delta smelt to be in the lower Sacramento River and Suisun Bay is not supported by any biological or modeling evidence of which I am aware. It is possible that such conditions will facilitate the downstream movement of larval and juvenile delta smelt from the upper Delta spawning areas to brackish water rearing habitat. However, the effectiveness of this water management protection action for protecting adult delta smelt and the applicability of particle tracking model results for predicting the movement of this life stage is, at best, unknown and, at worst, wrong. Unlike "particles" and young delta smelt migrating downstream, adult delta smelt make a directed, volitional migration upstream to Delta spawning areas.

b) Based on recent flow and operational data, Dr. Hanson's proposed "Tier 1" action can be expected to correspond with concurrent Old and Middle River flows ranging from -4,000 cfs to -9,000 cfs. *See* Figure 1, below. For example, in Water Year 2003, during periods in the winter and spring when flow on the lower San Joaquin River was in a net westerly direction (i.e., non-negative flow) the combined Old and Middle River flows were between -2,000 cfs (during the VAMP period) to -9,000 cfs, conditions that would likely entrain delta smelt into the central and south Delta and, according to the USGS analyses, would correspond to high take of the fish at the State Water Project ("SWP") and Central Valley Project ("CVP") export facilities.[3] Thus, Dr. Hanson is suggesting using a flow management objective to

[3] Important details regarding implementation of this action are not provided by Dr. Hanson (*e.g.*, where will flow on the lower San Joaquin River be measured, will it be measured as a daily value, a

protect delta smelt that has no known correlation with delta smelt abundance, survival, distribution or habitat quality, but which corresponds to a level of combined Old and Middle River flows known to cause high levels of take at the water export facilities.

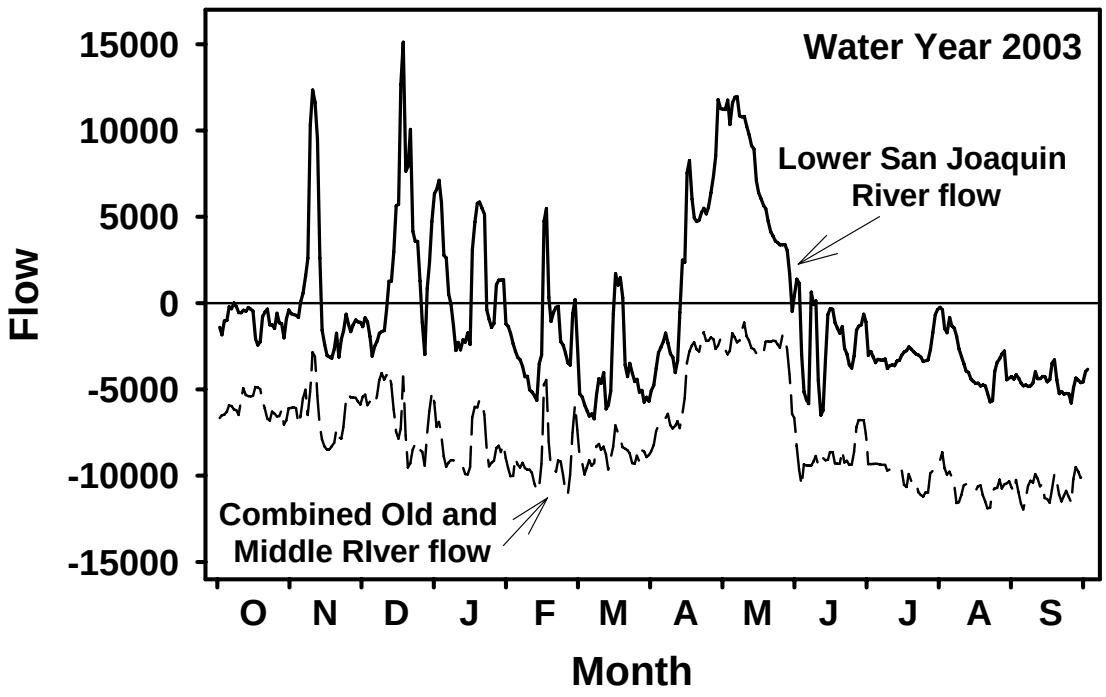


Figure 1. Daily flow values for the lower San Joaquin River and combined Old and Middle Rivers (y axis) for Water Year 2003 (x axis, as month). This graph shows that during periods when lower San Joaquin River flows were in a "net westerly" direction, or greater than 0 cfs, concurrent Old and Middle River flows ranged from approximately -2,000 cfs during the April-May VAMP period to approximately -4,000 to -9,000 cfs during the winter and early spring. Data source: California Department of Water Resources, Dayflow dataset.

c) During the winter, Dr. Hanson's "Tier 1" action will delay or preclude implementation of modifications in Old and Middle River flows triggered by changes in environmental conditions, such as an increase in turbidity resulting from increased Sacramento River flows,

---

5-day average, or a 14-day average?). This analysis assumes that Dr. Hanson intends for lower San Joaquin River flows to be measured at Jersey Point using the same methods used by CDWR for calculation of Dayflow data set for daily Delta water management and flows. CDWR's Dayflow dataset includes daily inflow, outflow and in-Delta channel flow conditions for the Delta. The data set is regularly used for hydrodynamic, biological and multi-disciplinary analyses by scientists and managers. Dayflow data are publicly available at: http://iep.water.ca.gov/dayflow/.

as recommended by USFWS as Action 1 in its Delta Smelt Action Matrix. As stated by Ms. Goude in her declaration, "[s]ince the most important factor for entrainment risk is proximity to the export pumps…, implementation of [USFWS] Action 1 is intended to reduce entrainment of adult delta smelt and result in a distribution that would minimize the entrainment risk for larval and juvenile delta smelt." Goude Reply Dec., ¶ 3. The objective of the USFWS action (as well as Plaintiffs' Interim Protection Action 4; *see* Appendix to this declaration as well as 7/23/07 Swanson Dec., Appendix 2) is to respond to the likely upstream movement of adult delta smelt stimulated by the seasonally increased inflows and/or turbidity with a protective action that, based on statistical relationship between Old and Middle River flows and delta smelt take at the SWP and CVP export pumps, would reduce the likelihood of entrainment and the numbers of fish lethally entrained. In contrast, Dr. Hanson recommends delaying management actions to moderate Old and Middle River reverse flows until, based on surveys with known limited detection ability and salvage of delta smelt, lethal entrainment of the delta smelt into the central and southern Delta and the export pumps has already occurred.

d) After delta smelt have become entrained into the central and south Delta and the export pumps, Dr. Hanson's "Tier 2" action proposes to moderate reverse flows on Old and Middle River to -6,000 cfs.[4] Dr. Hanson's proposal to wait to manipulate south Delta channel flow conditions until after entrainment has already occurred is contradicted by analyses conducted by the U.S. Bureau of Reclamation (USBR) described by Ms. Goude in her declaration. As Ms. Goude explains, "by the time a salvage event becomes apparent, it would likely be too late to provide significant protection; therefore proactive measures are necessary to minimize adult delta smelt salvage." Goude Reply Dec., ¶ 4. In addition to the "Tier 2" action being too late, based on statistically significant relationships developed by the U.S. Geological Survey (USGS) and relied upon by the DSWG and the USFWS (7/23/07 Swanson Dec.,

[4] Dr. Hanson has also recommended use of a 14-day running average to calculate and manage Old and Middle River flows, an approach that was earlier rejected by the DSWG as insufficiently precise and less protective than use of the 5-day average that they specified in their recommendations (March 27, 2007, as reported in the 4/2/07 DSWG notes (7/23/07 Swanson Dec., Exhibit U and ¶ 38.)

Figure 8 and ¶ 9), the level of protection afforded by Old and Middle River flows of -6,000 cfs is less than that recommended by either the USFWS or the DSWG. USFWS Delta Smelt Action Matrix for Water Year 2008, 10/10/06 DSWG notes (Exhibit T to 7/23/07 Swanson Dec.), 12/11/06 DSWG notes (Exhibit S to 7/23/07 Swanson Dec.).

e) Dr. Hanson's recommended Old and Middle River flow level of -6,000 cfs is more harmful to delta smelt than the average flows measured during most winter and early spring months during most years since 1999, the period during which the delta smelt population collapsed (7/23/07 Swanson Dec., Figure 9). Based on data collected by the USGS, average combined Old and Middle River flows were -6,603 cfs for January, -5,660 cfs for February, -4,970 cfs for March, and -4,761 for the first two weeks in April for the 1999-2007 period (excluding the wet year 2006). Dr. Hanson has based this flow objective on Johns' flawed reinterpretation of the Old and Middle River flow versus adult delta smelt salvage relationship and their erroneous conclusion that delta smelt salvage does not greatly increase until combined Old and Middle River reverse flows exceed -6,000 cfs (7/9/07 Johns Remedies Dec., ¶36).[5] This interpretation is not supported by research results of Dr. William Bennett of the University of California, Davis, (Bennett *et al*. 2006) that examined survival and population composition of delta smelt for several years during this period and showed that none of the delta smelt hatched during the period when Old and Middle River reverse flow conditions were within this range survived (*i.e.,* before the 31-day long San Joaquin River inflow enhancement and concurrent export curtailment required by Vernalis Adpative Management Plan [VAMP] was initiated, which typically begins in mid-April). Only delta

[5] CDWR's reinterpretation of the USGS delta smelt take versus Old and Middle River flow relationship is deeply flawed. Take of adult delta smelt at the water export facilities occurs from as early as November to as late as April, but within that period the majority of the seasonal take may begin at different times and usually occurs over a much shorter time. According to DSWG analyses, "[i]n most years, winter salvage occurs as one continuous event spread over time." Exhibit 3 (11/28/05 DSWG Meeting Notes). For example, in some years peak salvage occurs in December, while in other years, adult delta smelt may not be taken until February. In their analysis, CDWR arbitrarily partitioned the winter salvage and flow data into single months and used data from only January and February. This has the effect of artificially splitting a single year's adult delta smelt salvage data between two separate data sets in some years (*e.g.*, in 1996, 2000 and 2002; *see* 7/9/07 Johns Remedies Dec., Exhibits B and C) and ignoring data for years in which take occurred before January of after February. Contrary to CDWR's claim that this approach makes the analysis "more robust" (7/9/07 Johns Remedies Dec., ¶ 34), this approach instead weakens both the biological rationale and statistical power of the analysis. CDWR's use of this analysis to suggest that a threshold or inflection point exists for "high" take at reverse flows greater than -6,000 cfs, and that lower magnitude Old and Middle River reverse flows are protective of delta smelt, is not credible and is not consistent with USGS analyses or DSWG discussions and conclusions.

smelt hatched during the VAMP, when reverse flows on Old and Middle River flows were substantially lower (average flow of -1,515 cfs for the 1999-2005, 2007 period), were detected in the delta smelt population later in the summer and fall. *See* 7/23/07 Swanson Dec., ¶ 33 and Figure 8. In effect, Dr. Hanson's suggested "Tier 2" protection action is a continuation of the past water management operations that directly contributed to the species' decline.

f) For his "Tier 3" protection, Dr. Hanson recommends curtailing water export rates for a period of four days to reduce lethal entrainment of delta smelt only after there is a "dramatic increase" in salvage rates. Hanson Dec., ¶ 21. This approach modifies water management operations only after it is too late to provide any real benefit to the species, a conclusion similar to that reached by the USFWS based on USBR analyses. Goude Reply Dec., ¶ 4. It stands in stark contrast to the repeatedly stated objectives of the DSWG to minimize or eliminate entrainment. *See, e.g.*, Exhibits C, D, E, F, G, and I to 7/23/07 Swanson Dec. USFWS concerns that "increased losses will have an adverse effect on the delta smelt population" (Goude Reply Dec., ¶ 2), as well as the statement by the Director of the California Department of Fish and Game in recent testimony to Congress that "...actions must be taken to protect as many individual smelt as can be through manipulation of the water projects." Attachment 1 to the Declaration of Katherine Poole in Support of Plaintiffs' Proposed Remedies (7/2/07 Ryan Broddrick Statement) at 4. The use of short-duration export curtailments triggered by salvage events to protect delta smelt and reduce take has also been the official protection strategy for the species since 2000, when the CALFED Environmental Water Account (EWA) was implemented. Despite exhaustive reviews by state and federal agency scientists and an independent review panel, there is little or no evidence that this approach is effective at reducing export-related mortality, increasing population size, or contributing to species recovery. Exhibit 4 (EWA panel report). In their most recent report, the EWA Technical Review Panel stated that "the efficacy of the EWA as a tool for restoring and sustaining threatened fish populations in the Delta remain[s] to be determined." *Id.* Given the continuous decline in the delta smelt during the past seven years

in which this limited, reactive management approach for delta smelt protection has been in place, the water management scheme suggested by Dr. Hanson cannot be expected to provide sufficient protection for delta smelt.

g) Similar to the USFWS Delta Smelt Action Matrix, Dr. Hanson's proposed protection program relies on current CDFG survey programs and current SWP and CVP fish salvage monitoring to detect the presence and determine the distribution of delta smelt in the Delta and to trigger implementation of protection actions. DSWG biologists, Dr. Peter Moyle, and I have all cautioned against this, and recent management experiences have conclusively demonstrated the severe limitations of this approach. In a June letter to state and federal fisheries and water project agencies, Dr. Moyle and I warned that delta smelt "numbers have slipped to such low levels that too few may be available for reliable monitoring." Exhibit B to 7/23/07 Swanson Dec. (6/1/07 Moyle-Swanson letter). Later that month, the DSWG reported the same thing, stating that "confidence in the ability of the survey to adequately sample for delta smelt is questionable; further, such low numbers severely limit the validity of inferences that may be drawn from the survey data. As an example, surveys have not collected delta smelt at south Delta stations, but larval delta smelt have been salvaged at both the State and Federal facilities, which means that they occur in south Delta channels below levels at which they can be reliably detected by routine survey sampling." Exhibit R to 7/23/07 Swanson Dec. (6/11/07 DSWG notes).

h) Dr. Hanson's proposed "Tier 3" protection will never be triggered to protect small juvenile delta smelt (less than 20 mm in length) from lethal entrainment because fish this size are not even counted as fish salvage at the SWP and CVP export facilities. Loss of large proportions of this life history stage at the export pumps is thought to be a significant contributor the species' decline in recent years. Bennett 2005; Bennett *et al*. 2006. The limitations of our current monitoring and the urgent need for improved information in delta smelt presence and distributions are the basis for my recommendation that the current monitoring effort be increased. *See* Appendix, Actions 2 and 3.

i) Dr. Hanson's proposed protection program does not consider the known adverse effects of water management operations on delta smelt critical habitat that appreciably diminish its value for survival and for recovery of the species. Research results independently reported by two groups of scientists have shown that recent reductions in freshwater outflows from the Delta during the fall and resultant increases in salinity in the western Delta are statistically significantly related to declines in delta smelt population abundance. Guerin *et al*. 2006; Feyrer *et al*. 2007. Feyrer *et al*. (2007) further concluded that the increase in fall salinity "appears to be the result of water operations" from either reduced freshwater inflows, increased Delta exports, or both. While effective interim remedy actions to reduce or eliminate direct mortality of individual delta smelt at the pumps are an essential component of any plan to protect the species, concurrent efforts to protect delta critical smelt habitat and to reduce the adverse effects of water project operations on habitat quality are also necessary to avoid jeopardizing the species or further adversely modifying its habitat and to allow for recovery.

Comments on the Declaration of Bruce Oppenheim (Docket No. 433-3)

20. Mr. Oppenheim states that "most of the proposed remedial actions have beneficial effects on salmonids and green sturgeon," but he expresses concern that implementation of Plaintiffs' Action 10 to increase Delta outflows during the fall to improve delta smelt habitat conditions may adversely affect Endangered Species Act-listed winter-run and Sacramento River spring-run Chinook salmon in the summer and fall of 2008 by reducing the cold water pool volume in Shasta Reservoir. Oppenheim Dec., ¶¶ 3, 4, 5. As discussed below, however, there is no evidence for Mr. Oppenheim's stated assumption that the CVP's "Shasta Reservoir would be called upon to provide most of the water" to implement the delta smelt habitat protection action is provided by him or any other declarants. Oppenheim Dec., ¶ 4.

21. There are at least three strategies that can be employed singly or in combination by the state and federal water projects to modify operations to maintain Delta outflows at the levels that protect delta smelt critical habitat as proposed in Plaintiffs' Action 10 without causing potential adverse impacts on listed salmonid species on the Sacramento River. First, the projects can reduce

Delta export rates. Based on CDWR data, average fall export rates since 1994 have been 9,598 cfs for September (range: 7,149-11,510 cfs), 8,026 cfs for October (range: 4,605-10,755 cfs), 7,721 cfs for November (range: 4,313-9,981 cfs), and 7,866 cfs for December (range: 2,116-10,901 cfs). Given the minimum Delta outflow levels already required by the State Water Resources Control Board (SWRCB; SWRCB 2006; Oppenheim Dec., ¶ 4), reductions in exports would be sufficient to provide all of the additional outflow and would not reduce the Shasta Reservoir cold water pool or adversely affect listed salmonids or sturgeon on the Sacramento River. Second, the CVP and the SWP could increase releases from their other upstream reservoirs, including Oroville, Folsom and New Melones, instead of relying so heavily or exclusively on Shasta Reservoir. Third, the water projects could acquire water to increase Delta inflows from other rivers, including the Stanislaus, Tuolumne, and Merced in the San Joaquin River basin and the Yuba River in the Sacramento Basin. This is a strategy that has been employed regularly by the water projects during the past several years to acquire additional water to enhance stream flows and/or to compensate for reduced exports with the Environmental Water Account or Central Valley Project Improvement Act fish protection and habitat improvement programs.

22. Mr. Oppenheim also expressed concern that proposals to preclude installation of the Head of Old River Barrier ("HORB"), which protects San Joaquin basin fall-run Chinook salmon "by directing them away from Old River and subsequent entrainment at the CVP/SWP pumps." Oppenheim Dec., ¶ 7. However, the protection action that prohibits the installation of the HORB (Action 5 in the USFWS Delta Smelt Action Matrix and Action 10 in the Plaintiffs' proposal) is designed to reduce entrainment risk by helping to moderate reverse flows on Old and Middle River (which are also required to be reduced by other concurrent protection actions) and to facilitate the downstream movement of fish migrating through in south and central Delta channels. Assuming the risk of entrainment for juvenile San Joaquin basin salmon is similarly affected by the magnitude of Old and Middle River reverse flows as for delta smelt, it is likely that potential adverse effects of allowing a larger number of San Joaquin Chinook salmon to enter the southern Delta via Old River will be compensated for or outweighed by the improved south and central Delta channel flow conditions also provided by proposed protection plans.

Comments on the Declaration of Stephen Ford

23. In his declaration, Mr. Ford suggests that the description of delta smelt abundance and trends contained my earlier declaration did not "fully reflect the historical data" for the Fall Midwater Trawl survey. Ford Dec., ¶ 7. Similarly, he expresses concern that my comparison of 2007 20-mm survey results with those of the previous year did not "fully reflect the recent variability of delta smelt abundance" and noted that for the 20-mm survey, the number of delta smelt collected in 2006 at the completion of survey 8 of the CDFG 20-mm survey was the highest in seven years. Given that I included all of the available data for delta smelt for all years and all surveys in both tabular and graphical form, this concern seems misplaced. To supplement that information, I have included more detailed results from the CDFG 20-mm survey in Table 1 of this declaration.

24. Mr. Ford next describes his explanation for the differences in the numbers of delta smelt salvaged at the SWP and CVP facilities in June and July of 2007. Ford Dec., ¶¶ 10-15. He concludes that, because of SWP Clifton Court Forebay gate operations, the nine-day period during which the SWP pumped no water, and the lower pumping rates at the SWP compared to the CVP, the larger numbers of delta smelt salvaged at the SWP compared to the CVP in June and July must have come from a group of delta smelt that were entrained into the Forebay before the end of May rather than nearby Delta channels. Mr. Ford's conclusion is little more than speculation because there is no way to scientifically test or verify this conclusion with the presently available data or Delta hydrodynamic models. There are no data on presence or densities of delta smelt in the central and south Delta channels because the numbers of delta smelt in central and south Delta channels were below the detection limits of CDFG surveys. 7/23/07 Swanson Dec., Exhibit R (addendum to 6/11/07 DSWG meeting notes). There are no data on the presence or densities of delta smelt in Clifton Court Forebay because no surveys have been conducted. As far as I am aware, a particle tracking model with sufficient resolution to detect the differential influences of Clifton Court Forebay gate and CVP export operations on the Old and Middle River flows near the facilities does not exist.

25. According to delta smelt salvage data from previous years, both the numbers and densities (*i.e.*, number of fish acre-foot of water exported) of delta smelt salvaged routinely vary

between the two facilities, from 10-fold to more than 30-fold. For example, in June 2004, the same month of the year and a period during which SWP and CVP export operations were roughly similar to the second half of June 2007, SWP export rates averaged 56% lower than CVP export rates (the range of SWP rates was 94-13% lower than CVP rates). *See* Exhibit 5 (June 2004 CVO salvage/export report). Yet the SWP facility salvaged, on average, more than nine times as many delta smelt as the nearby CVP. As calculated from salvage and export data, delta smelt densities were 20 times higher at the SWP than at the CVP, despite the higher CVP pumping rates. If such a cursory review of delta smelt salvage data from other recent years yields patterns of salvage similar to that observed earlier this year, Mr. Ford's conclusion that, this year, all of the delta smelt salvaged were entrained into the Forebay months earlier does not seem reasonable.

26. Mr. Ford's main criticism of the Plaintiffs' protection actions is that they should include the adaptive management approach included in the USFWS Delta Smelt Action Matrix and be "more narrowly tailored to protect delta smelt based upon actual conditions in the watershed next spring and summer." Ford Dec., ¶¶ 33-34. With this criticism, Mr. Ford has ignored or dismissed the reasons I provided that, given the present imperiled status of the species and our reduced ability to accurately monitor fish presence/absence and distributions, such an approach would be insufficiently protective to avoid jeopardizing the species or adversely modifying its critical habitat. The key scientific information that was the basis for the Plaintiffs' recommended interim actions, as well as the use of technical information and discussions of potential and/or recommended protection actions in various DSWG meeting notes, CDWR's Pelagic Fish Action Plan and other material, are clearly described in my earlier declaration and in Appendix 2 of that declaration. I will not repeat them here.

27. Based on my years of experience working with delta smelt and studying the effects of water management operations on the species and its habitat, and my review of the available published and unpublished scientific information on delta smelt population status and trends, distribution patterns, survival rates and the relationships between these responses and environmental and water project operational variables, I do not believe that we have sufficient resolution or precision in either our monitoring capabilities or quantitative understanding of relationships between

environmental, operational and biological variables to apply such a reactive ("adaptive") approach in a manner that, given the present critically imperiled status of delta smelt, would be sufficiently protective to avoid jeopardizing the species or adversely modifying their critical habitat. This is why the quantitative objectives for water project operation modifications recommended in the Plaintiff's Interim Protection Actions 5 and 7 (*i.e.*, combined Old and Middle River flows greater than -1,500 cfs) were fixed at a level that, based on the best available science, is comparable to conditions observed during the only period of the spring from which newly hatched delta smelt have been shown to survive (*i.e.*, during the 31-day Vernalis Adaptive Management Plan, or VAMP). Other than the statistical relationships between delta smelt take and Old and Middle River flows (which were developed using data for adult delta smelt, not larvae or juveniles), there is little evidence that a protection action to modify Old and Middle River flows to allow higher magnitude reverse flows than are typical during the VAMP will be sufficiently protective to avoid killing most or all young delta smelt hatched during the period.

28. Regarding the Plaintiffs' recommendation that larval delta smelt (*i.e.*, fish smaller than 20 mm in length) be monitored at the SWP and CVP facilities, Mr. Ford offers three reasons that such a program should not be implemented. Ford Dec., ¶ 20. None of them are particularly credible. First, he suggests that it is too difficult and hazardous to sample for larval delta smelt because water velocities due to project pumping are too high. However, the objective of this action, simple detection of the presence of larval delta smelt at the export facilities, does not require that the fish be sampled directly from the export water flow. Instead, larval delta smelt could be sampled from Clifton Court Forebay, where the large area of the Forebay attenuates water velocity, or from the diverted water in fish holding tanks. Second, he suggests that other monitoring efforts, specifically the Kodiak Trawl survey and water temperature monitoring (both also included in the Plaintiff's Actions), are sufficient, stating that the "DSWG has consistently used data from the Kodiak survey and water temperature to evaluate smelt entrainment risk." Ford Dec., ¶ 20. The problem with this is that, because there is no monitoring for the presence of larval delta smelt at the export facilities, neither Mr. Ford nor the DSWG has any idea whether this strategy for evaluating entrainment risk is effective. Mr. Ford's third argument, that this type of action should be "left to

the scientists currently conducting the Pelagic Organism Decline investigation," misses the point of the proposed action. The purpose of the action, which is essentially an expansion of existing monitoring that is already required of the CVP and SWP, is to provide the USWFS and the water projects with essential information on the timing and magnitude of the impacts of their activities on the delta smelt. This information is needed by the USFWS and the water projects to accurately and efficiently implement the actions necessary to protect delta smelt and avoid inflicting adverse impacts that would jeopardize the species. Given the critically imperiled condition of delta smelt and the new science showing direct adverse effects of water export operations on the smaller life stages targeted by this monitoring effort, this proposed action is both reasonable and necessary to protect the species.

29. Mr. Ford notes that, for Plaintiffs' Action 4, the measurement period for the increase in Sacramento River inflow trigger is not explicitly stated. Ford Dec., ¶ 22. He is correct, and I have amended this trigger to agree with the three-day period recommended by the USFWS Delta Smelt Action Matrix. *See* Appendix. My inclusion of a trigger for increases in San Joaquin River flows was based on my own scientific understanding of the system and the likelihood that rapid flow increase on the this river could also stimulate delta smelt to move upstream. Regarding the use of changes in river flows versus turbidity as the trigger for implementing the protection action, these two variables are highly correlated (*i.e.*, when flows increase rapidly, turbidity also increases). As far as I am aware, it is not known which of these variables is the environmental cue used by delta smelt to trigger upstream movement. I think it likely that either of the these two environmental variables would be an effective trigger for implementing an action intended to reduce entrainment of upmigrating delta smelt into the central and south Delta by moderating Old and Middle River flow conditions.

30. Regarding the effect of Old and Middle River flows on delta smelt entrainment, Mr. Ford criticizes the use of the regression analysis done by Dr. Peter Smith of the USGS and suggests that the alternative analysis of these data produced by CDWR is more robust and informative. Ford Dec., ¶¶ 26-27. He is mistaken, for the following reasons. Take of adult delta smelt at the water export facilities occurs from as early as November to as late as April, but within that period the

majority of the seasonal take may begin at different times and usually occurs over a much shorter time. According to DSWG analyses, "[i]n most years, winter salvage occurs a one continuous event spread over time." Exhibit 3 (11/28/05 DSWG Meeting Notes). For example, in some years peak salvage occurs in December, while in other years, adult delta smelt may not be taken until February. In their analysis, CDWR arbitrarily partitioned the winter salvage and flow data into single calendar months and used data from only January and February. This has the effect of artificially splitting data from a single year's adult delta smelt salvage event between two separate data sets in some years (*e.g.*, in 1996, 2000 and 2002; *see* 7/9/07 Johns Dec., Exhibits B and C) and ignoring data from years in which take occurred before January or after February. Contrary to CDWR's claim that this approach makes the analysis "more robust" (7/9/07 Johns Dec., ¶ 34), this approach instead weakens both the biological rationale and statistical power of the analysis. CDWR's use of this analysis to suggest that a threshold or inflection point exists for "high" take at reverse flows greater than -6,000 cfs and that Old and Middle River reverse flows maintained at -6,000 cfs are protective of delta smelt is not credible and is not consistent with USGS analyses, DSWG discussions and conclusions (*e.g.*, Exhibit T to 7/23/07 Swanson Dec. (10/10/06 DSWG notes)), USFWS conclusions (Goude Reply Dec., ¶ 4), or data for seasonal Old and Middle River flows during the past several years and delta smelt population trends.

31. In his review of Plaintiffs' Action 10, Mr. Ford has updated the graph presented as Figure 4 in my earlier declaration with juvenile delta smelt abundance data from 2005, 2006 and 2007. Ford Dec., ¶ 39. He reports that, with the inclusion of these recent data, the simple linear relationship between delta smelt abundance and fall western Delta salinity is no longer statistically significant. He is correct. The abundance of juvenile delta smelt in 2005, 2006 and 2007 was much lower than would have been predicted based on the simple linear relationship between delta smelt abundance and western Delta salinity in the fall that was developed using the previous 17 years. However, the recent data are too few and the range of recent fall salinity levels too narrow to determine whether or not the relationship between delta smelt abundance and fall salinity still exists for the species at its new critically low population level.

32. Mr. Ford does not provide an updated version of the more rigorous and sophisticated analysis conducted by his own staff scientists that was recently published in the peer-reviewed scientific literature as Feyrer *et al*. (2007), although he does provide a copy of the article as Exhibit B. In contrast to the simple analysis first reported by Guerin *et al*. (2006) and reinterpreted by me in my earlier declaration, CDWR scientists showed that recent declines in the quality of delta smelt habitat during the fall were related to multiple variables, the most important being salinity and turbidity, and that the decline in habitat quality was significantly related to declines in delta smelt population abundance. They attributed the adverse changes in turbidity to the "long-term effects of upstream dam construction" which reduced the sediment supply to the estuary and reported that the adverse changes in salinity were "the result of water operations," either declines in Delta inflows, increases in Delta exports, or both. Thus, according to peer-reviewed, published scientific research conducted by water project agency scientists, CVP and SWP water projects operations have and continue to adversely modify delta smelt critical habitat, appreciably diminishing is value to the species and its recovery. Clearly, interim protections for delta smelt must include actions that address these adverse impacts.

33. Mr. Ford's use of his simplistic and incomplete re-analysis of the fall salinity-delta smelt abundance relationship as an argument against implementing Plaintiffs' Action 10, the only protection action proposed by any party to address the adverse impacts and modification of delta smelt critical habitat by water project operations, is neither persuasive nor credible. Ford Dec., ¶ 39. The more important information raised by recent abundance data is the indication that, since 2004, abundance of juvenile delta smelt has dropped precipitously compared to levels that previously were reliably predicted by fall salinity conditions. Federal and state agencies responsible for protecting and recovering delta smelt should interpret this analysis as another indication that the species has fallen to a new critically imperiled state during the past several years and recognize the scientific evidence that the decline is associated with the adverse impacts of water project operations on both the species and its critical habitat.

Comments on the Declaration of Curtis Spencer (Docket No. 429)

34. The declaration of Mr. Spencer describes an elaborate analysis and development of a mathematical model that purports to predict delta smelt salvage rates, to calculate the number of delta smelt present in the SWP's Clifton Court Forebay, and to determine the source of delta smelt salvaged at the SWP export facilities this spring and summer. In my opinion, the analysis is seriously flawed and the mathematical model is far too simplistic to support his highly speculative conclusions. The model results he describes are neither credible nor informative for a number of reasons.

a) Well-designed and robust mathematically models are developed using data from multiple years and a wide ranges in the relevant model variables. The data upon Mr. Spencer's mathematical model is based are insufficient because the data for the salvage, export, and Clifton Court Forebay volume variables are from less than three months during a single year in which the range of the model variables is small. The short period from which the data are derived was also characterized by extreme levels of most of the model variables, including: (a) unprecedented low delta smelt numbers that were known to be below the level of a detection for the ongoing CDFG 20-mm survey whose results were needed to provide corroborating data for development of the mathematical model; and (b) unprecedented low SWP and CVP export rates, including a period during which no water was exported by the SWP.

b) Fish salvage data from the SWP and CVP export facilities are known to be seriously flawed and biased towards underestimating the numbers of fish lethally entrained in water diverted by the SWP and CVP facilities for several reasons. First, only a fraction of the fish entrained into the SWP's Clifton Court Forebay are successfully transported in the export flow to the louvers (*i.e.*, the type of fish "screen" used at both facilities, *see* 7/23/07 Swanson Dec., ¶¶ 22-23) that are intended to divert the fish into holding tanks for salvage and counting. For example, results of experiments with Chinook salmon indicate that more than 75% of fish entrained into Clifton Court Forebay never reach the louvers but instead are preyed upon or die somewhere in the Forebay (Brown *et al*. 1996). Pre-screen loss numbers are not known

for delta smelt, but no credible scientist or engineer would assume that they are zero. Second, research by USBR scientists has shown louvers to be very inefficient at screening delta smelt from exported water. Bowen *et al*. (2004) reported efficiencies for delta smelt for a single set of louvers of less than 65% under most export flow conditions. Given that both facilities use two sequential sets of louvers to divert fish to salvage tanks, and therefore fish must be "successfully" screened by both louvers in order to be salvaged, overall efficiencies for diverting delta smelt from exported water into the salvage tanks are probably well below 45%. Third, only fish larger than 20 mm in length are counted as salvage; smaller fish that are seen are not measured or counted. Fish length data collected by CDFG surveys concurrent with the period from which Mr. Spencer obtained salvage data indicate that a substantial fraction of the delta smelt population was smaller than 20 mm in length, contributing another source of error into Mr. Spencer's analysis.[6] All of these limitations with the salvage data have been previously reported (*e.g.*, Brown *et al*. 1996; Bowen *et al*. 2004; Herbold *et al*. 2005) and, based on my professional interactions with state and federal fisheries and water export facilities staff, are widely known and acknowledged. However, none of these issues and potential sources of error were considered by Mr. Spencer except as after-the-fact assumptions that they did not exist and would not be incorporated into his mathematical model, which by his report was designed to describe fish salvage at the SWP. Spencer Dec., ¶ 28. This alone is enough to discount the model, its results, and his conclusions.

c) Just as the CDFG monitoring surveys for delta smelt are less reliable because delta smelt numbers are so low, the ability of the SWP and CVP salvage monitoring programs to accurately and precisely quantify the numbers of fish entrained into the facilities is questionable. There is a high likelihood that the salvage monitoring, which samples only a small fraction of the exported water, will fail to detect presence of the fish even when they are in fact present, adding even more error to the data used by Mr. Spencer in his model.

[6] Fish length data collected at the salvage facilities would not be useful to address this potential source of error because salvaged fish that are smaller than 20 mm in length are neither measured nor counted.

d) Contrary to accepted standards for analysis and model development, there is no evidence that Mr. Spencer made any attempts to test alternative hypotheses to explain the origins of the delta smelt salvaged by the SWP. Even if the quality of the empirical data used in Mr. Spencer's analysis were better and his assumptions weren't invalid, the data's limited scope (*i.e.*, just three variables were used) is insufficient to do this or to support his conclusion that all delta smelt salvaged at the SWP during June and July were fish entrained into Clifton Court Forebay at the end of May. At a minimum, data on the presence or absence of delta smelt in central and south Delta channels and in Clifton Court Forebay throughout the three month period are needed to test the conclusion. However, because delta smelt numbers were so low that they were below the detection limit of CDFG surveys data for the central and south Delta channels, these data could not be obtained without an increased sampling effort and, as far as I am aware, no attempts were made to survey delta smelt in the Forebay. In the alternative, two different suggestions for operational manipulations to try to determine the origins of the SWP-salvaged delta smelt were made by the DSWG but, as far as I am aware, were not implemented. Exhibit 6 (6/25/07 DSWG Meeting Notes). As another example, a logical alternative hypothesis for the differences between delta smelt salvage rates at the SWP and the CVP would be that there are different salvage efficiencies between the two facilities, a reasonable explanation supported by the facts that the CVP is older, in poor repair, subsamples fish for salvage counts less frequently, and is operated differently than the SWP.[7, 8] In fact, this is the rationale for my recommended Action 2 to increase the frequency of salvage sampling at the CVP. *See* Appendix.

35. For the reasons outlined above, Mr. Spencer's analytical exercise and model are not a scientifically credible rebuttal of the negative impacts of SWP export operations on delta smelt this

[7] For example, as I understand it, in order to clean debris from the louver panels at the CVP fish salvage facility, the panels must be removed from the water, allowing export flow and entrained fish to bypass the louvers and be transported, undetected, directly to the pumps.

[8] Similarly, Mr. Ford provides no evidence to support his dismissal of differences in salvage efficiency between the SWP and CVP facilities as a possible explanation for the differences in delta smelt take at the two facilities. (Ford Dec., ¶ 5; *see also* comments on Ford Dec. above)

past spring and summer, nor do they provide scientific support for the failure of the water project agencies to implement protective water management operational changes repeatedly recommended by the DSWG. 7/23/07 Swanson Dec., Table 2.

Comments on the Reply Declaration of John Leahigh (Docket No. 428)

36. Mr. Leahigh provides a detailed but inaccurate argument in favor of managing and measuring compliance with recommended Old and Middle River flows using a 14-day running average, instead of the 5-day average specified by the DSWG (Exhibit U to 7/23/07 Swanson Dec. (DSWG notes, April 2, 2007)) and recommended in the Plaintiffs' recommended interim protections. Leahigh Reply Dec., ¶ 30-35. He first states that the 14-day period represents a full lunar tidal cycle (*Id.*, ¶ 30). This is incorrect. A full lunar tidal cycle that includes both spring and neap cycles is 28 days long, the period of the lunar month. He next states that use of a 14-day average is consistent with the averaging periods used for water management and compliance with water quality standards such as those required for the Delta by the SWRCB. While this is correct for water quality standards for salinity (measured as electrical conductivity, or EC), it is not correct for water quality standards for flow or exports, the two metrics most relevant to proposed delta smelt protection actions. The 2006 Water Quality Control Plan (as well as the 1995 plan in place for the previous 12 years) established quantitative objectives for river flows and Delta outflow that are specified to be met on a daily basis using a 3-day running average or as a monthly average with a requirement that the 7-day average not fall below some fraction of the monthly objective. *See* Exhibit 7 (SWRCB 2006, Table 3)**.** Objectives for combined CVP and SWP export rates are specified to be met using a 3-day running average. *Id.* Based on my close observation of water project operations and management during the past several years, CVP and SWP project operators are extremely skilled at managing this admittedly dynamic system to comply with these regulatory objectives. I believe they are equally capable of meeting additional management objectives for Old and Middle River flows established to protect the endangered delta smelt.

37. The issue of the measurement interval for meeting Old and Middle River flow objectives has already been examined and resolved by the DSWG, following a request by the

WOMT to address their concerns regarding the effects of spring-neap tidal cycles on flows in these channels. Notes from the April 2, 2007 DSWG meeting (attached as Exhibit U to the 7/23/07 Swanson Dec.) describe discussion of this issue by the scientists charged by the USFWS to determine changes in water project operations necessary to protect delta smelt. The DSWG reported several conclusions. First, they noted that "the protective action the DSWG recommends is keyed to the actual [Old and Middle River] flows" and that if flows were negative (or southward) it was not "relevant to delta smelt protection what percentage of the southward flow [was] attributable to the spring/neap cycle and what to pumping." Second, the DSWG reported their concern that allowing a longer averaging period "would imply DSWG agreement that a larger degree of variation in day-to-day [Old and Middle River] flows, possibly including periods of several days where southward flow substantially exceeds the DSWG's recommended limit" and that this would "reduce the degree of protection afforded by the action." More strongly, the DSWG stated their opinion that "such additional variation might very well reduce protection for delta smelt." The DSWG acknowledged that Old and Middle River flows did vary over time "because of various natural causes" and stated that they were "therefore not concerned by small variations in the 5-day average" for Old and Middle River flows. At the time of the discussion, the water projects were operating to meet a DSWG recommendation for Old and Middle River flows and the DSWG reported that "they were satisfied with the Project's efforts." The DSWG concluded their discussion with an unequivocal recommendation that the water projects "continue to use a five-day average flow when tracking [Old and Middle River] flows." Exhibit U to 7/23/07 Swanson Dec.

38. Mr. Leahigh's analysis of water costs for implementation of the Plaintiffs' recommended interim protection actions includes the assumption that salvage of juvenile delta smelt would continue through mid-July. Leahigh Reply Dec., ¶ 24. He bases this on examination of historical salvage of delta smelt since 1993, which shows that in half of those years seasonal salvage of young delta smelt ended on July 10. However, during that period, reverse flows on Old and Middle Rivers averaged -3,265 cfs in June (range: -8,853 to 8,747) and -7,760 cfs in July (range: -897 to -10,819 cfs). Based on particle tracking modeling and statistical relationships between Old and Middle reverse and take of adult delta smelt, these conditions correspond to high rates of

entrainment of fish into the central and south Delta and into CVP and SWP fish salvage facilities. Under the much lower reverse flow conditions for Old and Middle River specified in Plaintiffs' Action 7 and the preceding months (*i.e.*, Plaintiffs' Actions 5 and 6), it is likely that the movement of young delta smelt from the Delta channels and sloughs where they were hatched to downstream rearing areas near the confluence and in Suisun Bay and beyond the influence of the export pumps would have been improved and few or no fish would remain in the south Delta as late as July.

Comments on the Declaration of Ronald Milligan (Docket No. 433-2)

39. Mr. Milligan criticizes the Plaintiffs' Actions 4, 5 and 7, not on the basis of the degree of protection the actions will afford delta smelt, but because the Old and Middle River flows objectives were presented as "a specific flow …. without a range." Milligan Reply Dec., ¶ 4. He argues that a range "allows for some operational flexibility" to implement these actions "given the dynamic nature of the estuary." *Id.* As noted above in my comments on Mr. Leahigh's declaration, based on my observations, CVP and SWP project operators are extremely skilled at managing this "dynamic" system to successfully comply with multiple regulatory objectives, most of which set at some specific level, not a range. With few and infrequent exceptions, the SWRCB does not "allow the project operators the latitude to respond… to changing circumstances" as Mr. Milligan suggests will be necessary to implement modifications of water project operations to protect the critically endangered delta smelt. However, in response to the operational concern raised by Mr. Milligan, as well as similar concerns expressed by Mr. Leahigh, I have provided additional information to describe Old and Middle River flows objectives for Plaintiffs' Action 4, 5, and 7. This information is intended to clarify and address practical considerations relating to water project operational capabilities and compliance methods. The flow objectives are now expressed as a range centered on the specific flow level I identified as necessary to protect delta smelt from adverse effects of water projects operation. These minor changes will not reduce the overall level of protection to delta smelt and their habitat provided by the recommended actions.

40. Mr. Milligan also expresses concern that implementation of Plaintiffs' Action 10 will "reduce the amount of cold water available to protect salmon and steelhead in the Sacramento

valley." Milligan Reply Dec., ¶3. Like Mr. Oppenheim, Mr. Milligan incorrectly assumes that the proposed action to protect delta smelt habitat can only be implemented by increasing releases of water from Shasta Reservoir. Oppenheim Dec., ¶¶ 4- 5. However, as discussed in more detail above, there are at least three strategies that can be employed singly or in combination by the state and federal water projects to modify operations to maintain Delta outflows at the levels that protect delta smelt critical habitat as proposed in Plaintiffs' Action 10 without causing potential adverse impacts on listed salmonid species on the Sacramento River. First, the action can be implemented by reducing Delta export rates. Based on recent fall export rates that averaged between 7,700 cfs (in November) to more 9,500 cfs (in September), and given the minimum Delta outflow levels already required by the State Water Resources Control Board (SWRCB; SWRCB 2006, and Oppenheim Dec., ¶ 4), reductions in exports would be sufficient to provide all of the additional outflow to implement the action. Second, the CVP and the SWP could increase releases from their other upstream reservoirs, including Oroville, Folsom and New Melones, instead of relying so heavily or exclusively on Shasta Reservoir. Third, the water projects could acquire water to increase Delta inflows from other rivers, including the Stanislaus, Tuolumne, and Merced in the San Joaquin River basin and the Yuba River in the Sacramento Basin. This is a strategy that has been employed regularly by the water projects during the past several years to acquire additional water to enhance stream flows and/or to compensate for reduced exports with the Environmental Water Account or Central Valley Project Improvement Act fish protection and habitat improvement programs.

Comments on the Declaration of William J. (B. J.) Miller (Docket No. 407)

41. In his declaration, Dr. Miller attempts to make two arguments: (1) that there is little or no effect of water project export rates on delta smelt population abundance, and (2) that the population abundance of delta smelt is instead controlled by whether or not the young fish encounter food in their habitat. Neither of Dr. Miller's contentions are supported by the data, his deeply flawed analyses, or the impressive amount of scientific research on the species that has been completed and synthesized in the past several years, including that published in the peer-reviewed scientific literature (little of which is discussed or used by Dr. Miller in his declaration).

42. Reports of research and analysis results showing statistically significant relationships between delta smelt population abundance and water export rates have been presented by Bennett (2005), myself (Swanson 2005), and Manly (2006) and, as reported by Ms. Goude in her declaration, confirmed by Drs. Manly and Chotkowski in a personal communication to her. To provide an example, I have updated my earlier analysis of the effects of wintertime exports on the abundance of delta smelt measured the following fall in Figure 2.

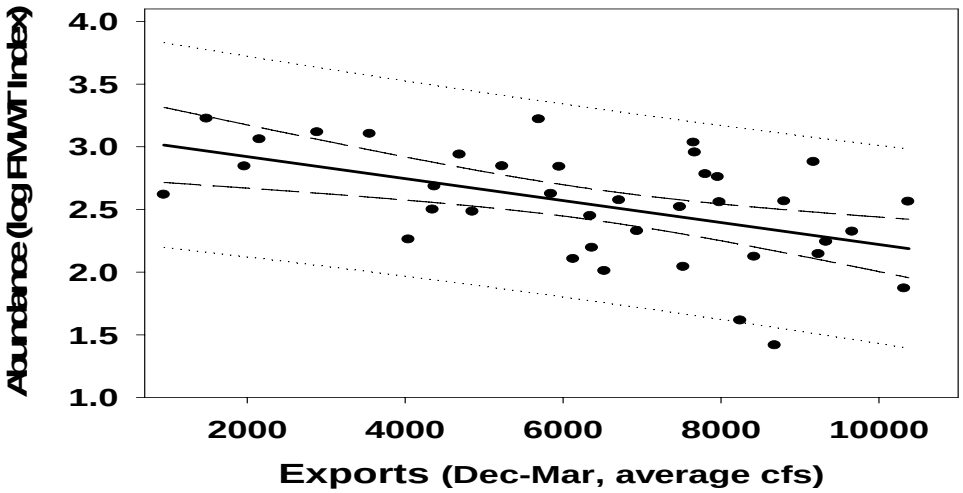


Figure 2. Relationship between winter export rates and the population abundance of delta smelt measured the following fall. Winter export rates (x axis) are the average combined export rate for the CVP and the SWP for the December-March period, the period during which adult delta smelt move into the Delta to spawn. Abundance of delta smelt (y axis) is the log transformed Fall Midwater Trawl abundance index, which measures the abundance of the next generation of delta smelt the following fall. This graph shows that in years with high wintertime exports, the size of the delta smelt population as is significantly lower than in years with low wintertime export rates. Data sources: California Department of Water Resources, Dayflow dataset, and California Department of Fish and Game, Fall Midwater Trawl survey.

Using data from 1967-2007, the regression equation for this analysis is:

> Adult delta smelt abundance = 3.097 – 0.0876(winter export rate)
> n=38, r^2=0.255, p=0.001
> where: adult delta smelt abundance is the log of the FMWT abundance index; and winter export rate is the average CVP+SWP exports from December through March, expressed as cfs x 1000.

43. This equation shows that in years when winter exports are high, the abundance of delta smelt measured later in the fall will be low, while years with low winter exports will have higher delta smelt population the following fall. Based on the r^2 value, this simple linear regression

equation explains 25% of the variation in delta smelt population abundance measured during the past 41 years.

44. As a second step, I added another variable into the analysis to account for the large differences in delta smelt population abundance measured during the past four decades and to account for the significant stock recruitment relationship exhibited by the species (*i.e.*, the abundance of adult delta smelt is dependent on the numbers of juvenile delta smelt present earlier in the year). The multiple regression equation for this analysis is:

> Adult delta smelt abundance
> = 2.658 + 0.398(juvenile delta smelt abundance) – 0.0623(winter export rate)
> n=36, r^2=0.483, p<0.001 for effect of juvenile delta smelt abundance, and p=0.027 for the effect of winter export rate
> where: adult delta smelt abundance is the log of the FMWT abundance index; juvenile delta smelt abundance is the log of the Summer Townet abundance index; and winter export rate is the average CVP+SWP exports from December through March, expressed as cfs x 1000.

45. This equation shows that the population abundance of adult delta smelt is significantly affected by both the abundance of the delta during the juvenile life stage measured earlier in the year and water export rates that occurred during the previous winter when fish in this generation were produced. Both of the variables have a statistically significant effect on adult delta smelt abundance. Adult delta smelt are more abundant in years when juvenile abundance is high and low when there are fewer juvenile fish. After consideration of this factor, adult delta smelt abundance is still higher in years when winter exports were low and lower in years with high winter export. These two variables explain nearly 50% of the observed variation in delta smelt abundance during the past four decades.

46. Dr. Miller states that Dr. Manly "found a flaw" when reviewing an analysis of the effects of winter exports on delta smelt population abundance I presented in 2005. Miller Dec., ¶ 4. This is not a correct characterization of Dr. Manly's review. 6/21/07 Manly Dec., Exhibit 4 (Docket Nos. 373, 373-5, 373-6). Dr. Manly's review confirmed the statistical significance of the simple linear regression between winter export rates and delta smelt abundance, reporting that "the regression of log [FMWT] values against the winter export rate is highly significant." *Id.* Dr.

Manly's report then provided a series of alternative analyses of the same data that were, based on my understanding of delta smelt biology, highly questionable. For example, he based his alternative analyses on the assumption that the possible effects of winter exports on delta smelt were different during the 1969-1982 period than during the 1983-2005 period and used this as a rationale to partition the long-term data set, an approach that weakens the power of any statistical analysis because it reduces both sample size and the ranges of variables tested. He also assumed that the abundance of delta smelt in one year was largely controlled by the abundance of the species two years earlier (but not the year before), an assumption that for an annual species like delta smelt is unreasonable.

47. Despite clear evidence of the significant relationship between seasonal water export rates and delta smelt abundance, export rates are not the only or even the most useful variable for examining the effects of water project operations on delta smelt. It is a coarse measurement that does not reflect, respond to, or drive other important variables such as inflows, in-Delta channel flows, Delta outflows, or the location of low salinity habitat. Most of the recent research and analysis has focused on other metrics of water project operations and of the effects of those operations on delta smelt critical habitat. This is why none of the interim protection actions proposed by any party protect delta smelt by directly modifying export rates.

48. Dr. Miller's second argument and related analyses, that the abundance of delta smelt is primarily determined by whether young delta smelt co-occur with their zooplankton prey in their habitat, are equally flawed. I do not know of any biologist working on in this system who would argue with the statements that zooplankton populations (as either biomass or density) are very low in the upper estuary and Delta or that food limitation may be contributing to low fish populations measured in recent years. There is no scientific basis, however, to conclude from those statements or from the results of Dr. Miller's analyses that food is the single most important factor controlling delta smelt population size. Dr. Miller is not a biologist.

49. Dr. Miller's analytical approach is flawed and, in my opinion, would not withstand peer-review. For his analysis, Dr. Miller has created a variable using selected data from CDFG surveys for juvenile delta smelt and zooplankton and then related this variable to CDFG's FMWT

abundance index for adult delta smelt using a simple linear regression. Based on the explanations provided in this and Dr. Miller's earlier declaration (Docket No. 374), I am not able to determine how the data are selected or manipulated to produce this co-occurrence variable. Dr. Miller violates at least one important statistical assumption by not log-transforming the data (or using some other accepted statistical transformation method). He has arbitrarily partitioned the data into a number of shorter time periods and then conducted his analysis on only subsets of the data (*e.g.*, based on his exhibits, 1981-2005, 1981-2006, 1993-2005, 1995-2005, and 1996-2005). For a relationship as fundamental as food and fish abundance, Dr. Miller's hypothesis and statistical model should be able to withstand or explain longer term changes in variables. Finally, results of Dr. Miller's analysis are impossible to interpret because his co-occurrence variable is opaque: it combines quantitative aspects of two different variables (zooplankton abundance and juvenile delta smelt abundance) together, effectively precluding determining whether one or the other of the two components has a more important effect (or any at all) on the response variable, adult delta smelt abundance. Delta smelt are known to show a strong stock recruitment relationship: the abundance of adult fish measured by the FMWT is strongly dependent on the abundance of juvenile delta smelt measured by the TNS earlier the same year. Because Dr. Miller uses results from surveys for juvenile delta smelt as a component in his co-occurrence variable, it is likely (but impossible to determine from Dr. Miller's results) that the relative importance of the zooplankton component of co-occurrence variable is low.

Comments on the Reply Declaration of Jerry Johns (Docket No. 432)

50. Mr. Johns begins his comments on the Plaintiffs' proposed interim protections with the statement that CDWR does not support implementation of Plaintiffs' Action 10, the only delta smelt protection proposed by any party that is designed to address the known adverse effects of reduced Delta outflow resulting from CVP and SWP water project operations on delta smelt crucial habitat. Johns Reply Dec., ¶ 5. Both of the reasons he states for this decision, that (1) "it is not practical" in dry years because it would cost too much water, and (2) the action has "high scientific uncertainty," are not supported either the information he cites or the facts reported in this and other

declarations. Regarding the amount of water needed to implement the action, Mr. Johns cites estimates included in the California Resource Agency's Pelagic Fish Action Plan. Exhibit Q to 7/23/07 Swanson Dec. at 47-48. These estimates are more than twice as high as the estimates reported by Mr. Rosekrans, Mr. Leahigh, and Mr. Milligan, a result that is not surprising since the protection described in Pelagic Fish Action Plan is different than Plaintiffs' Action 10. Contrary to Mr. Johns' claim that the "scientific uncertainty" of the action is high, there is no uncertainty that fall Delta outflows are lower as a result of water project operations upstream and in the Delta. There is also no uncertainty that fall outflows in recent years are lower than just two or three decades ago. Further, published, peer-reviewed research conducted by CDWR scientists has demonstrated the these seasonal reductions in Delta outflows have adversely modified delta smelt critical habitat and that this water project related habitat degradation is significantly related to the abundance of the delta smelt and has contributed to the recent population of the species. Plaintiffs' Action 10 is designed to address this known adverse habitat modification. Failure to implement this action will result in environmental conditions that appreciably diminish the value delta smelt critical habitat for the species survival and recovery.

51. Mr. Johns expresses tentative support for the revisions to the USFWS Delta Smelt Action Matrix proposed by the State Water Contractors (SWC) and described by Dr, Hanson in his declaration. Johns Reply Dec., ¶ 10. I have provided a detailed response to Dr. Hanson's proposal in my response comments to Dr. Hanson's declaration above, which I will not repeat here. In summary, Dr. Hanson's proposed interim protections for delta smelt a deeply flawed and clearly insufficient to avoid jeopardizing the species or adversely modifying its habitat for multiple reasons. First, the proposed protections and, in particular, the flow levels for the lower San Joaquin, Old and Middle Rivers are not supported by the scientific analyses cited and the proposal ignores results of other relevant (and higher quality) science relevant to delta smelt and its habitat. Second, it relies on actions that have no known relationship to delta smelt abundance, survival, distribution, or habitat. Third, implementation of the proposed levels for flows on the lower San Joaquin, Old and Middle Rivers will result in conditions that are similar to or worse than those observed in the Delta during the past five to eight years when the delta smelt population collapsed to it current critically low

levels. Fourth, the proposal contains no acknowledgement or protection against the known adverse effects of water project operations on delta smelt critical habitat.

52. Mr. Johns next offers support for the deeply flawed analyses described by Mr. Ford and Mr. Spencer and proposes that, based on their conclusions, only salvage monitoring results from the CVP export facility should be to determine whether delta smelt have been entrained into the south Delta and taken at the export facilities. Johns Reply Dec., ¶ 14. I have already provided detailed review and response comments to Mr. Ford's and Mr. Spencer's declarations, and will not repeat them here. However, even without reviewing this information, Mr. Johns' proposal to actually reduce the amount of monitoring information we collect and use to management and protect this species is inconsistent with the need to provide stronger, rather than weaker, protections for this species.

53. Mr. Johns next argues that, if the projects were allowed "more flexibility" to implement the USFWS Delta smelt Action Matrix protections, it would reduce water costs, citing the cost of delta smelt protection actions in 2007 as the basis for his estimate that 500 thousand acre-feet of water would be "reasonable." Johns Reply Dec., ¶¶ 15-16. His use of 2007 delta smelt protection is perplexing, given that none of the protections urgently recommended by the DSWG from mid-May through July were actually implemented by the CVP and SWP. *See* 7/23/07 Swanson Dec., Table 2. If this is an example of the "flexible" implementation envisioned by Mr. Johns and CDWR, then any proposal for interim protection of delta smelt and their critical habitat that includes this approach will be clearly insufficient to avoid jeopardizing the continued existence of the species.

54. Mr. Johns' suggestion that a 500,000 acre-foot supply of water, comprised in all or part of environmental water resources already dedicated to protection of other species and habitats, should be used to implement interim protections for the critically imperiled delta smelt in 2008 is insufficient. His estimate is not even close to the estimates made by Mr. Rosekrans, Mr. Leahigh, and Mr. Milligan for implementing either the USFWS' or the Plaintiffs' proposals. Mr. Johns' suggestion that the EWA be used to supply the majority of this amount is particularly problematic. Johns Reply Dec., ¶19. Despite its name, the EWA does not reduce overall exports from the Delta or provide additional water to improve delta smelt critical habitat. Instead, the EWA is used to

compensate for protective export reductions made at one time in the year (usually in the spring) by giving EWA water to the water projects for export later in the year (usually in the late summer and fall). Thus, the EWA has actually functioned to increase Delta export rates during the fall to levels higher than the maximum allowed for export of project water supplies, effectively increasing the magnitude of the water project-related adverse modification of delta smelt critical habitat during this sensitive period. Mr. Johns' proposal to continue this scheme further demonstrates CDWR's disregard for the known adverse impacts of water project operations on delta smelt critical habitat and a poor understanding of what is necessary, based on multiple lines of scientific evidence, to avoid jeopardizing the continued existence of delta smelt or adversely modifying critical habitat and is insufficient to allow for recovery of the species.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

DATED: August 13, 2007

Christina Swanson, Ph.D.

References

Aasen, G. A. 1999. Juvenile delta smelt use of shallow-water and channel habitats in California's Sacramento-San Joaquin Estuary. California Fish and Game 85:161-169.

Bennett, W. A. 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. San Francisco Estuary and Watershed Science 3(2):1-71.

Bennett, W. A., J. A. Hobbs, and S. J. Teh. 2006. Delta smelt growth and survival during the recent pelagic organism decline: what causes them summertime blues. CALFED Science Conference, October 23-25, 2006, Sacramento, CA. Abstract available at: http://sciconf.abag.gov/conferences/abstract_view_01a.php.

Bennett, W. A., W. J. Kimmerer, and J. R. Burau. 2002. Plasticity in vertical migration by native and exotic fishes in a dynamic low-salinity zone. Limnology and Oceanography 47:1496-1507.

Bowen, M. D., B. B. Baskerville-Bridges, K. W. Frizell, L. Hess, C. A. Carp, S. M. Siegfried, and S. L. Wynn, 2004. Empirical and experimental analyses of secondary louver efficiency at the Tracy Fish Collection Facility, March 1996 to November 1997, Tracy Fish Facility Studies, Volume 11, U. S. Bureau of Reclamation, Mid Pacific Region, Denver Technical Service Center, 33 pp + Figures.

Brown, R. S. Greene, P. Coulston, and S. Barrow. 1996. An evaluation of the effectiveness of fish salvage operations at the intake of the California Aqueduct, 1979-1993. Pages 497-518 in J. T. Hollibaugh, editor. San Francisco Bay: the ecosystem. Pacific Division of the American Association of the Advancement of Science, San Francisco, CA.

Environmental Water Account Technical Review Panel (EWA Panel). 2007. Review of the 2006 Environmental Water Account (EWA). Submitted by the EWA Technical Review Panel, January 2007, to Dr. Michael Healey, Lead Scientist, Claifornia Bay-Delta Authority. 37 pp. Available at: http://science.calwater.ca.gov/pdf/ewa/EWA_2006_final_report_013107.pdf

Feyrer, F. B, M. L. Nobriga, and T. R. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. Canadian Journal of Fisheries and Aquatic Sciences 64:723-734.

Grimaldo, L. and B. S. Ross, and D. Sweetnam. 1998. Preliminary results on the age and growth of delta smelt (*Hypomesus transpacificus*) from different areas of the estuary using otolith microstructure analysis. Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1998:25-28.

Gurein, M. G. Gartrell, and R. Denton. 2006. Linkage between fall salinity, Delta outflow and delta smelt population decline. CALFED Science Conference, October 23-25, 2006, Sacramento, CA. Abstract available at: http://sciconf.abag.gov/conferences/abstract_view_01a.php.

Herbold, B., C. Armor, R. Baxter, M. Chotkowski, P. Coulston, M. Nobriga, and T. Sommer. 2005. Historical patterns in salvage data. In: IEP synthesis of 2005 work to evaluate the pelagic organism decline (POD) in the upper San Francisco Estuary. Available at: http://www.science.calwater.ca.gov/workshop/workshop_pod.shtml.

Manly, B. F. J. 2006. Review of analyses presented at the Environmental Water Account meeting December 7-8, 2005. 52 pp. Manly declaration, June 21, 2007, Exhibit 4.

Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller. 1992. Life history and status of delta smelt in the Sacramento-San Joaquin estuary, California. Transactions of the American Fisheries Society 121:67-77.

State Water Resources Control Board (SWRCB). 2006. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta estuary. Division of Water Rights, State Water Resources Control Board, California Environmental Protection Agency. December 2006. Available at: http://www.waterrights.ca.gov/baydelta/docs/2006_plan_final.pdf

State Water Resources Control Board (SWRCB). 1995. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta estuary. State Water Resources Control Board, California Environmental Protection Agency. 95-1WR, May 1995.

Swanson, C. 2005. Effects of exports on delta smelt population abundance – preliminary analyses. Annual Review of the Environmental Water Account, Dec. 7-8, 2005, Sacramento, CA, and available at: http://science.calwater.ca.gov/workshop/ewa.shtml.

U.S. Geological Survey (USGS). 2003. Editor's Comments-Peer Review of the 2002 San Luis and Delta-Mendota Water Authority White Paper "The Delta Smelt and the State of the Science."

APPENDIX

Revised Recommended Interim Protection Actions for Delta Smelt

(To be implemented from August 2007 until completion of the new USFWS Biological Opinion)

Monitoring Actions							
Action #	**Timing**	**Life Stage**	**Trigger(s)**	**Action**	**End of Action**	**Objective**	**Source and Rationale**
1	Year-round as relevant to specific survey	all	none	Continue to fully implement all CDFG surveys for delta smelt, including (but not limited to) the FWMT, Summer TNS, Spring Kodiak, and 20-mm surveys	none	Provide information on abundance and distribution of delta smelt	Continuation of ongoing monitoring programs is essential to ability to assess delta smelt abundance and distribution within their critical habitat
2	December-July	all	1) Increase in Delta outflow by: a) increase in Sac River flow at Freeport to 25,000 cfs; or b) increase in San Joaquin River outflow by >10 % over three days (DSWG notes 10/10/06 and 12/11/06); or 2) FMWT and/or Kodiak survey data on delta smelt distribution indicating fish moving upstream of the confluence and into the Delta; or 3) by January 15 (same DSWG notes); whichever comes first.	Increase frequency of sampling for entrained fish at the CVP fish protective facilities to a minimum of 25% of the time (e.g., a minimum of a 15 min count every 1 h)	June 15 or a minimum of 5 days after the last detection of larval or juvenile delta smelt at the either the SWP or CVP fish protective facilities by either the salvage or larval monitoring program, whichever comes last.	Improve detection of delta smelt entrained into the CVP facilities.	Current sampling frequency at CVP (approximately 8% of time, or 1/12 of the time) has a low level of detection and given current low population abundance of delta smelt is likely to fail to detect delta smelt when they are in fact present and being salvaged.

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
3	January-May	Larval and young juvenile delta smelt	Onset of spawning as determined by: 1) Kodiak survey data of maturation stage of delta smelt or presence of "spent" delta smelt in survey samples; or 2) Delta water temperature >12ºC (i.e., within the 12-18ºC spawning temperature range); or 3) detection of larval delta smelt in the 20-mm survey or at the SWP and CVP fish salvage facilities (see Monitoring Actions); whichever comes first.	Implement monitoring program for detection of larval delta smelt (i.e., delta smelt <20 mm in length) at both the SWP and CVP fish protective facilities. Sampling should be conducted at a minimum of four times daily, evenly spaced in time during both the day and the night.	June 15 or a minimum of 5 days after the last detection of larval or juvenile delta smelt at the either the SWP or CVP fish protective facilities by either the salvage or larval monitoring program, whichever comes last.	Detect presence of larval delta smelt smaller than 20 mm in length at the SWP and CVP facilities.	Recent research by Dr. W. Bennett suggests that entrainment loss of larval and small juvenile delta smelt is contributing to the population decline. Current sampling at the SWP and CVP neither detects nor reports loss of fish smaller than 20 mm in length. A sampling program for these smaller fish is essential to increase detection of small delta smelt in the southern Delta, improve information on delta smelt distribution during this critical life stage, and trigger changes in water project operations to protect the species.

Water Project Operations Actions							
Action #	**Timing**	**Life Stage**	**Trigger(s)**	**Action**	**End of Action**	**Objective**	**Source and Rationale**

4	Winter (December 25-February)	Pre-spawning adult delta smelt	1) Increase in Delta outflow by: a) increase in Sac River flow at Freeport to 25,000 cfs over three days; or b) increase in San Joaquin River outflow by >10 % over three days (DSWG notes 10/10/06 and 12/11/06); or 2) FMWT and/or Kodiak survey data on delta smelt distribution indicating fish moving upstream of the confluence and into the Delta; or 3) by January 15 (same DSWG notes); whichever comes first.	1) Following trigger event #1, restrict export increases during wintertime pulse flow events to levels that avoid negative flows on Old and Middle Rivers (i.e., $\geq$0 cfs, 5-day average) for a minimum of 10 days following trigger event #1 and then modify water project operations to achieve combined Old and Middle River flows between -2750 and -4250 cfs (5-day average); or 2) If action triggered by #2 or #3, manage water project operations to achieve combined Old and Middle River flows of between -2750 and -4250 cfs (5-day average).	Onset of spawning as determined by: 1) Kodiak survey data of maturation stage of delta smelt or presence of "spent" delta smelt in survey samples; or 2) Delta water temperature >12ºC (i.e., within the 12-18ºC spawning temperature range); whichever comes first.	Prevent and/or reduce lethal entrainment of pre-spawning delta smelt.	Action is based on analyses and protective actions developed by the DSWG (10/10/06 and 12/11/06 notes) and incorporated by CDWR in their Pelagic Fish Action Plan (March 2007). Recommended Old and Middle River flow range is centered on a target flow of -3500 cfs which is: a) equal to the lower end of the range of negative flows recommended by the DSWG (12/11/06 notes); b) the lower end of the range of negative flows specified in the Pelagic Fish Action Plan; and c) higher (i.e., less negative, more protective) than average negative flows measured during January and February during the 1999-2005, 2007 period (Figure 9). The range for allowable variability is 1500 cfs, the same as the range for Old and Middle River flows successfully implemented in late winter and early spring 2007.

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
5	Late Winter-Spring (February-April 15)	Spawning adult, larval, and young juvenile delta smelt	Onset of spawning as determined by: 1) Kodiak survey data of maturation stage of delta smelt or presence of "spent" delta smelt in survey samples; or 2) Delta water temperature >12ºC (i.e., within the 12-18ºC spawning temperature range); or 3) detection of larval delta smelt in the 20-mm survey or at the SWP and CVP fish salvage facilities (see Monitoring Actions); whichever comes first.	Manage water project operations to achieve combined Old and Middle River flows of between -750 and -2250 cfs (5-day average).	April 15 or the start date of the Vernalis Adpative Management Program (VAMP).	Prevent and/or reduce lethal entrainment of spawning adult, larval and young juvenile delta smelt; facilitate transport of larval and juvenile delta smelt downstream from Delta channels to the confluence and Suisun Bay	Action is based on: a) results of analyses by Dr. W. Bennett that showed that only delta smelt hatched during the VAMP survived to the summer and fall; and b) average Old and Middle River flows measured during the VAMP for the 1999-2005, and 2007 period (average=-1515 cfs) (Figure 9). Recommended Old and Middle River flow range is centered on a target flow of -1500 cfs with a range for allowable variability of 1500 cfs, the same as the range for Old and Middle River flows successfully implemented in late winter and early spring 2007. Recommended flow is similar to the protection action to moderate or eliminate Old and Middle negative flows prior to the VAMP identified in CDWR's Pelagic Fish Action Plan.

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
6	April 15 – May 15, or as specified by VAMP technical Team	Larval and juvenile delta smelt	Beginning of VAMP	Implement the Vernalis Adpative Management Plan (VAMP) San Joaquin River flow enhancement and SWP and CVP export curtailment as specified under the VAMP experimental design.	End of VAMP	Prevent and/or reduce lethal entrainment of larval and young juvenile delta smelt; facilitate transport of larval and juvenile delta smelt downstream from Delta channels to the confluence and Suisun Bay	This protective action is based on results of analyses by Dr. W. Bennett that showed that only delta smelt hatched during the VAMP survived to the summer and fall. Implementation of the San Joaquin River flow enhancement component of VAMP is presently required under the SWRCB's water quality objectives for fish and wildlife beneficial uses (SWRCB 1995)

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
7	Late Spring -Early Summer (May 15, or end of VAMP – June)	Larval and young juvenile delta smelt	End of VAMP	Manage water project operations to achieve combined Old and Middle River flows levels of between -750 and -2250 cfs (5-day average).	June 15 or a minimum of 5 days after the last detection of larval or juvenile delta smelt at the either the SWP or CVP fish protective facilities by either the salvage or larval monitoring program, whichever comes last.	Prevent and/or reduce lethal entrainment of larval and young juvenile delta smelt; facilitate transport of larval and juvenile delta smelt downstream from Delta channels to the confluence and Suisun Bay	Action is based on: a) results of analyses by Dr. W. Bennett that showed that only delta smelt hatched during the VAMP survived to the summer and fall; and b) average Old and Middle River flows measured during the VAMP for the 1999-2005, and 2007 period (average=-1515 cfs) (Figure 9). Recommended Old and Middle River flow range is centered on a target flow of -1500 cfs with a range for allowable variability of 1500 cfs, the same as the range for Old and Middle River flows successfully implemented in late winter and early spring 2007. This protective action to moderate Old and Middle River negative flows after the VAMP is similar to that recommended by the DSWG in 2007.

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
8	Late Winter - Early Summer (December-June)	Spawning adult, larval, and young juvenile delta smelt	Onset of spawning as determined by: 1) Kodiak survey data of maturation stage of delta smelt or presence of "spent" delta smelt in survey samples; or 2) Delta water temperature >12ºC (i.e., within the 12-18ºC spawning temperature range); or 3) detection of larval delta smelt in the 20-mm survey or at the SWP and CVP fish salvage facilities (see Monitoring Actions); whichever comes first.	Prohibit installation or tidal operation of the three south Delta agricultural barriers	June 15 or a minimum of 5 days after the last detection of larval or juvenile delta smelt at the either the SWP or CVP fish protective facilities by either the salvage or larval monitoring program; whichever comes last.	Prevent and/or reduce lethal entrainment of larval and young juvenile delta smelt; facilitate transport of larval and juvenile delta smelt downstream from Delta channels to the confluence and Suisun Bay	This protective action is based on results of particle tracking modeling results that show that tidal operation of the south Delta agricultural barriers increases entrainment of particles into the SWP and CVP under a range of water project operational levels (DSWG notes, 10/30/06, 1/11/07). This protective action is nearly identical to that identified by CDWR in the Pelagic Fish Action Plan and recommended by the DSWG in 2007.

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
9	Late Winter-Early Summer	Spawning adult, larval, and young juvenile delta smelt	Onset of spawning as determined by: 1) Kodiak survey data on delta smelt maturation stage; 2) Delta water temperature >12ºC (i.e., in the 12-18ºC spawning temperature range; or 3) detection of larval delta smelt in the 20-mm survey or at the SWP and CVP fish salvage facilities (see Monitoring Actions); whichever comes first.	Prohibit installation of the Head of Old River Barrier	June 15 or a minimum of 5 days after the last detection of larval or juvenile delta smelt at the either the SWP or CVP fish protective facilities by either the salvage or larval monitoring program, whichever comes last.	Improve Old and Middle River downstream flows; prevent and/or reduce lethal entrainment of larval and young juvenile delta smelt; facilitate transport of larval and juvenile delta smelt downstream from Delta channels to the confluence and Suisun Bay	This protective action is based on results of hydrodynamic modeling and empirical Delta channel flow observations that show that installation of the Head of Old River Barrier exacerbates reverse flow conditions in Old and Middle River, and USGW analyses that show that take of delta smelt at the SWP and CVP facilities is directly related to the magnitude of reverse flows on Old and Middle Rivers.

Action #	Timing	Life Stage	Trigger(s)	Action	End of Action	Objective	Source and Rationale
10	Fall (September-December)	Juvenile and sub-adult delta smelt	Location of X2 (as 14-day running average upstream of 80 km on September 1.	Manage water project operations to maintain Delta outflows at a minimum of 7500 cfs or maintain X2 (as 14-day running average) at downstream of 80 km, whichever requires less freshwater outflow.	December 15 or first winter pulse flow (see Action 1, trigger #1), whichever comes first.	Improve and protect habitat quality of delta smelt by increasing the volume and quality of low salinity habitat; shift the distribution of the delta smelt population further away from SWP and CVP-related sources of mortality (e.g., entrainment); reduce the abundance and upstream distribution of the invasive clam *Corbula* and resultant impacts of planktonic supply for delta smelt.	This protective action is based on results of research by Feyrer *et al.* (2007) that showed that reduced Delta outflow during the fall degraded delta smelt habitat quality; and results of research by Guerin *et al.* (2006) that showed that abundance of juvenile delta smelt was reduced following fall seasons in which Delta outflows were low and western Delta salinities were elevated (i.e., X2 shifted upstream); and results of research by USGS that showed that *Corbula* had become established further upstream in the estuary following years with reduced fall Delta outflows (J. Thompson, 2007 CALFED Science Program workshop on Variable Salinity in the Delta). It is similar to the summer-fall action identified by CDWR in the Pelagic Fish Action Plan.

Notes:
1. For all delta smelt protection actions, combined Old and Middle River flows are to be calculated as the 5-day average, as recommended by the DSWG (4/2/07 notes).

EXHIBIT 1

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Office of the Director
Reston, Virginia 20192

In Reply Refer To:
Mail Stop 300
#20040150

MEMORANDUM

JAN 1 2 2004

To: Assistant Secretary - Water and Science
Assistant Secretary - Fish, Wildlife and Parks

From: Charles G. Groat, Director, U.S. Geological Survey
Steven A. Williams, Jr., Director, U.S. Fish and Wildlife Service

FEB 2 7 2004

Subject: Results of the Peer Review of the San Luis and Delta–Mendota Water Authority's White Paper titled "The Delta Smelt and the State of the Science"

As per your request of October 21, 2002, the U.S. Geological Survey (USGS), in collaboration with the Fish and Wildlife Service (FWS) completed a peer review of the subject white paper on delta smelt.

We applied the rigorous peer review process that the USGS uses for all science and other documents. This process requires reviewer anonymity and no involvement in the subject research effort. It further requires the 'editor' to manage the process with the highest standards of professionalism and integrity. Two reviewers were from the USGS, one from the FWS, and one was from academia. All reviewers have exceptional fisheries science expertise and credibility. Please find attached the individual reviews completed by four independent reviewers as well as a synopsis of the collective results compiled by the editor.

In summary, the White Paper recognizes the need for an updated status review for delta smelt and actually presents a partial analysis to assist that process. However, the paper lacks sufficient scope and scientific rigor to present a compelling argument that a designation of threatened status is no longer warranted for the smelt.

If you have additional questions regarding this report, please contact Dr. Susan Haseltine, of the USGS, at 703-648-4050, or Gary Frazer, of the FWS, at 202-208-4646.

Attachments

United States Department of the Interior

U. S. GEOLOGICAL SURVEY
Biological Resources Division
909 First Avenue, 8th Floor
Western Regional Office
Seattle, Washington 98104

November 6, 2003

Memorandum

To: Susan D. Haseltine
Associate Director for Biology

From: Ronald E. Kirby
Senior Advisory Biologist, Western Region

Subject: Editor's Comments—Peer Review of the 2002 San Luis and Delta-Mendota Water Authority White Paper "The Delta Smelt and the State of the Science"

Following are my synthesis comments on the peer review of the delta smelt document. I first describe the material under review. Then I summarize the reviewers' overall conclusions. Finally, I collate the comments from the reviewers in a point-by-point analysis of the conclusions claimed by the authors of the white paper.

No attempt is made to reiterate the sum of the arguments presented by the reviewers. The original comments should be consulted for such details. Nor do I develop an additional set of review comments. Instead, I present through summary the main points germane to assessment of the science quality of this document. This synthesis text should be read in conjunction with a thorough reading of the individual peer review texts.

The Subject Document

The full citation of the paper reviewed is:

San Luis & Delta–Mendota Water Authority. 2002. The delta smelt and the state of the science: a white paper reviewing the 1993 listing of delta smelt as threatened and a review of recent science concerning the delta smelt. 5 pp + Appendices A, B, and C.

The text consists of a two-paragraph *Introduction*, two paragraphs of *Conclusions* containing three major points, and two paragraphs of *Background* (words in italics are section titles within the document). Twelve paragraphs support the following statements (which are the conclusions) in a section entitled *The state of the science*:

- "Since the mid 1980s—well before the fish was listed as threatened—the population of delta smelt has been increasing."

- "Recent analyses indicate that the number of sub-adult (i.e. fall) delta smelt present in the Bay-Delta ecosystem in the late 1990s was at least 1 million and ranged up to 12 million."

- "Using these population estimates, the probability of extinction of delta smelt can be estimated. If the population of sub-adults is in the range of 12 million (the 1999 estimate), the probability of extinction by the year 2050 is about one to two tenths of one percent."

The paper then presents two paragraphs of *Conclusion*(s) which include 1) the statement that there is "a compelling argument for removing the delta smelt from both California's and the U.S. government's threatened species list" and 2) a request that water allocation decisions that favor the delta smelt be revisited.

The text contains no literature citations but internally and indirectly refers to the attached appendices. The text, in effect, reiterates the conclusions of these appendices:

> Appendix A (Manley, Miller, and Hillman 2002. *Trends in the fall midwinter trawl abundance index for delta smelt*) analyzes recent delta smelt abundance data and concludes, " The fall midwinter trawl index has shown an upward trend for approximately the last 15 years." This appendix cites a draft report to CALFED and two mathematical references.
>
> Appendix B (Miller and Britton 2002. *Estimating the population of sub-adult smelt*) explains data manipulation methods, defines assumptions, and provides a table of abundance indices. "Conservatively low" estimates of the sub-adult population are calculated to range from 1 to 18 million from 1996-1999. Calculation sheets are provided. This appendix cites a personal communication, a memorandum, and the USFWS 1996 recovery plan for Sacramento/San Joaquin Delta Native Fishes.
>
> Appendix C (Miller 2002. ***Converting sub-adult delta smelt population estimates to*** *estimates of adult population*) consists of text explaining assumptions and the named estimates. Estimates of the adult population range from a low of 200,000 to a high of 300,000 to 1,600,000. This appendix cites Appendices A and B, the aforementioned draft paper to CALFED, and Moyle et al. on the life history of the delta smelt.

Peer Review Comments

Overall Assessment—There was unanimity of opinion among the four peer reviewers that the conclusions reached in the paper were not supported by either the data or the arguments presented. The reviewers criticized both the selective use of data and application of questionable analytical techniques. The reviewers viewed the assumptions accepted in the analyses (which the authors termed "conservative") as unsupportable with the evidence provided. The authors were viewed as having ignored the results and implications of their work that were contrary to their conclusions. Most importantly, in their focus on delta smelt abundance indices, the authors were viewed as having ignored the important aspects of the life history of this organism which include their 1) severely restricted geographic range, 2) one year life cycle, and 3) semelparous life history.

There was unanimity that the authors selected data specifically to support only certain points and that the overall effort was extremely weak scientifically. The data presented were not viewed as "new" by the reviewers as claimed by the authors and commonly accepted methods for analyzing data of the sort in this paper were not used. All reviewers questioned various portions of the analyses, which they viewed as inconsistent with the generally accepted meaning of the term and lacking in rigor.

Detailed comment—The conclusions of the white paper depend entirely upon the analyses of the three appendices. Specific comments supporting the summary paragraphs above are provided first for the appendices and then for the paper proper.

Appendix A (Manley, Miller, and Hillman 2002. *Trends in the fall midwinter trawl abundance index for delta smelt*)

> The reviewers' overall conclusion was that the authors failed to demonstrate a positive trend in delta smelt abundance. The statistical techniques were found questionable in that the authors only visually fitted different lines to a single subset of the data (limited time series) without any analysis that would permit evaluation of supposed trends. Specifically, there were no statistical tests to determine positive or negative trends and there was no discussion of either significance or power of the results. Reviewer 4 supported this criticism by applying modern techniques to the data and found the opposite trend from that claimed by the authors. Given the availability of many statistical packages appropriate to analyses of this sort, their common and accepted use in the scientific literature, and the great amount of data available to the authors, the authors' choice of visual line fitting was deemed inexplicable and not in keeping with standard scientific practice.
>
> Especially troublesome to the reviewers was the focus of this analysis on only one of the life stages available for delta smelt. Reviewer 4 pointed out that the text provided no rationale from the ecological perspective that justified the authors' use of only the autumn mid-water trawl, when the literature emphasizes the value of summer tow-net abundance indices. The lack of discussion of causal factors that would put any trend identified in context was found to be a fatal shortcoming. Even reviewer 3, who allowed

that the analysis showed a turnaround in the "trend" based upon the assumptions used, did not accept that possibility as removing risk from the population as claimed by the authors. Reviewer 2's concern about bias in the analysis is well taken and is supported by comments from the other reviewers. Risks to the population from both anthropogenic and climatic factors were listed by the reviewers as major concerns in evaluating these abundance indices, regardless of analytical outcome.

Appendix B (Miller and Britton 2002. *Estimating the population of sub-adult smelt*)

The reviewers rejected the assumptions, methodology, and conclusions of this appendix. A statistically significant positive trend, as claimed, is not presented. Knowledge of the life history of the fish, especially its preferred depth and areal distribution, was not incorporated in analysis. The comparison of catches with different gear and scaling of density data to obtain population estimates was found unsupportable as were the estimated correction factors used to offset trawl "inefficiency." Importantly, and fatal to the argument in this appendix, the use of a correction factor for the Kodiak trawl was questioned by the reviewers from several viewpoints. Scaling up of zero values is found unacceptable given the assumptions listed, life history of the fish, and limitations of the gear. Reviewer 2 provided some suggestions on how this analysis might have been conducted including deletion of outlier data and recognition of the "noise" inherent in data of this type. Reviewer 4 provided calculations showing how removal of one outlier point dramatically changes the entire analysis presented by the authors.

Appendix C (Miller 2002. *Converting sub-adult delta smelt population estimates to estimates of adult population*)

The reviewers found the uncertainties in the calculations in Appendix B, which led to rejection of Appendix B's conclusions, dramatically increased by the assumptions accepted in this appendix. Therefore, the estimates of the numbers of adults as calculated in this appendix were judged invalid as well.

Further summarization is best organized within the categories defined by the authors of the document, i.e., the three conclusions, and also the concluding remarks in the final section of the document:

- "Since the mid 1980s—well before the fish was listed as threatened—the population of delta smelt has been increasing."

  The reviewers found that the data presented do not support this conclusion. Instead, it is clear that there is large inter-annual variability as expected from a species with this life cycle.

- "Recent analyses indicate that the number of sub-adult (i.e. fall) delta smelt present in the Bay-Delta ecosystem in the late 1990s was at least 1 million and ranged up to 12 million."

The reviewers deemed the procedures used to reach this conclusion unacceptable. At least four steps in the calculations have been found in either error or dependent upon critical assumptions that were omitted in analysis. The numbers obtained are therefore unsupportable as estimates of population size.

- "Using these population estimates, the probability of extinction of delta smelt can be estimated. If the population of sub-adults is in the range of 12 million (the 1999 estimate), the probability of extinction by the year 2050 is about one to two tenths of one percent."

  The reviewers found the first two conclusions unrealistically optimistic and based on questionable science. They therefore found the use of these conclusions to reach this last conclusion a severe underestimate of the probability of extinction risk. Importantly, this statement of extinction risk is based upon an unpublished model that has no associated risk factors, there is no estimation of likelihood of such risks, nor is this conclusion based upon commonly accepted methods of Population Viability Analysis.

The reviewers' comments on the final section of the paper (*Conclusion*) provide a final assessment of the white paper:

> The reviewers found this section contained statements not supported by either the paper proper or the appendices. The reviewers did not agree that this paper proved that the population was increasing, nor did they agree with the estimation of probability of extinction. They concluded that even if the population were increasing, that in and of itself would not be sufficient to conclude that the threat to the population was significantly less than previously thought. This last argument was made specific by repeated comment by the reviewers that the life history of the fish was not properly considered in these analyses and that the consequences of a within-year catastrophe for the species were unappreciated by the authors. Thus, contrary to assertions by the authors, the reviewers did not find this paper "a compelling argument for removing the delta smelt from both California's and the U.S. Government's threatened species list."
>
> The paper's final argument was that, based upon the conclusions of this white paper, water allocation decisions within the Central Valley Project and the State Water Project should be revisited. This issue was beyond the scope of the analysis of the science of the document and was not commented upon by the reviewers.

The peer reviewers provided detailed discussion on every point of the paper and its appendices, made specific suggestions regarding alternative analytical techniques (and in some cases reanalyzed the authors' data to illustrate their comments), specifically mentioned ancillary data that should be brought to bear on the topic, and throughout suggested organizational rearrangements that would make this document an acceptably scientific analysis and a presentation in conformance with standard and accepted methods of reporting science. The reviewers have provided literature citations they believe pertinent and have suggested numerous ways in which this overall analysis could be improved. We hope these are useful to the authors. The peer reviewers and I appreciated the opportunity to address the issues raised in the San Luis & Delta–Mendota Water Authority's 2002 assessment, The *delta smelt and the state of the science: a white paper reviewing the 1993 listing of delta smelt as threatened and a review of recent science concerning the delta smelt.*

(signed) Ronald E. Kirby

Attachments: Peer review comments from Reviewers 1-4

Review of ***The Delta Smelt and the State of the Science***

This "paper" is actually a reiteration of the three documents that I review below.

Introduction

The paper gets off to a bad start by showing a misunderstanding over what happened in the Klamath Basin. The regional economy was not threatened with "sudden and catastrophic collapse" because of cut-off of the water (farming is a small percentaqe of the economy) during a period of severe drought. The NRC report did not say there was "insufficient science" but that the agencies failed to adequately consider alternative explanations for the results of *some* of their studies. There has been no general "re-examination of … the scientific foundations of Endangered Species Act determinations" by reputable groups because there is good evidence the process has generally worked well, all things considered (as expressed in other NRC reports).

The author's state their intention is to examine "the state of the science in connection with the status of the delta smelt…". However, this paper and its attached appendices address only data collected by one survey, the Fall Midwater Trawl Survey (FMWT). The authors ignore other important data sources such as the Suisun Marsh Survey and numerous analyses done by other researchers studying this species and the larger biotic community of the San Francisco Estuary. This paper is not, in any way, a comprehensive review of what is known about delta smelt in particular or the San Francisco Estuary more generally, nor is it an evaluation of the "state of the science." It *is* a seriously flawed analysis of a limited set of selectively chosen data, designed to support a predetermined conclusion.

Conclusions I find the location of this section unusual and suggestive of their approach. At this point in the paper, the authors have not presented a context or rationale for these conclusions, hypotheses which are to be tested, nor any methodology used to asses these hypotheses. Regardless, each of these conclusions is based on erroneous assumptions and/or heuristic impressions of the data.

(1) The assertion that the delta smelt population "has been increasing" since the mid-1980's is demonstrably false. Based on the data presented in this paper (FMWT indices), it would be correct to say that the delta smelt population has displayed the high inter-annual variability typical of this and all other semelparous, annual species. In 2002, the Suisun Marsh Survey (which began in 1980) recorded very low catches of delta smelt – among the lowest seen in the data set as a whole.

(2) The authors claim that the delta smelt population has recently ranged between 1 million and 12 million individuals. As I explain below, the procedure used to generate this estimate is completely without merit. It is extremely unlikely that delta smelt populations have reached these levels in recent years. Even if the population had been as high as the authors estimate, the species would still be at grave risk of extinction because many of the threats faced by this species (e.g., entrainment on the Delta pumps, widespread collapse of Delta levees by earthquake or flood, major chemical spills, invasion of non-native predators, competitors, or pathogens, etc.) are completely unrelated to population size or density.

(3) Based on the previous two assertions, the authors suggest that the extinction risk for delta smelt is <0.2% over the next 48 years. Any effort to model extinction risk based on #1 and #2 above severely underestimates extinction risk because the inputs are unrealistically optimistic. Also, the extinction-risk estimate does not (and probably cannot) account for the risk of catastrophic events that threaten delta smelt in its limited range.

I am sympathetic to the author's point in the final paragraph of page 1. It would be nice if we had adequate historical abundance data from sampling gear that caught delta smelt. It would also be nice if we understood delta smelt ecology well enough to interpret survey results in terms of population size. We are making tremendous strides on the latter front; but unfortunately, the best data long-term data we have for

delta smelt comes from sampling gear that is not well-designed for catching delta smelt. The existing data are very useful for assessing population *trends*, but they are not much good for estimating the absolute abundance of delta smelt in any one year. Fortunately, knowing the exact number of delta smelt in the Estuary at any point in time is not necessary to protect and manage the delta smelt population.

Background

This is a rather meager summary of the biology of delta smelt considering this paper purports to be determining "the state of the science." It is interesting that even the tiny amount of life history information presented here is largely ignored in the analyses. In the second paragraph, the authors assert, with no documentation, that the listing of the delta smelt has "resulted in a substantial loss of water for agriculture, municipal, and industrial uses." There is no doubt that water project operations have been changed as the result of the smelt (and other species) but whether there has been substantial loss due *solely* to smelt is open to question. A strong and bald assertion like this requires reference to real analyses of water budgets and economics.

The state of the science

The authors claim that the Service's analysis of the Delta smelt's population status was "misleading". However, the authors then present two other comparisons that they believe demonstrate a population increase *since* listing. It is not clear how this supports their point that the Service's initial evaluation *leading to the listing* was misleading.

The authors then refer to a paper by Manly, Hillman, and Miller (*unpublished;* attached as an appendix) to support their claim that the population has increased over the past 15 years. I discuss this paper in detail below. The authors' claim that Manly et al. (*unpublished*) present a "thorough statistical analysis" is false. The referenced paper presents no statistical analyses whatsoever. Thus, their claim that Manly et al. (*unpublished*) "shows a significant increasing trend in the abundance of delta smelt" is also false.

Next the authors restate their claim that delta smelt populations ranged between 1-12 million in the years 1996-1999. This claim is based on another paper (Miller and Britton *unpublished,* also attached as an appendix). Miller and Britton (analyzed in more detail below) is based on a non-significant correlation between the FMWT and another sampling gear (the Kodiak Trawl) which is much more effective at catching delta smelt. The authors of both papers seem to be unaware that failure to detect a significant correlation between two data sets means that one cannot use results of data set "A" to predict results of data set "B". Even if there were a statistically significant correlation between delta smelt catches by the two gear types, Miller and Britton's procedure for estimating Kodiak Trawl catches using historical catches by the FMWT is hopelessly optimistic.

The authors then reiterate their third point, that extinction of delta smelt in the near future is unlikely based on a current, estimated spawning population of 1 million individuals. The authors base this claim on a mathematical model created by Manly (*unpublished*). No descriptions of the risk factors or estimation of their likelihood or impacts are included. No statistical analyses of the results are presented. Because the results of this model are based on optimistic speculations about the current population size of delta smelt (*see above and below*) and because I have no way of evaluating whether the model parameters are comprehensive or realistic (but strongly suspect that they are neither), the resultant estimate of population risk is nothing more than wishful thinking.

The rest of this section presents a legal rationale for the Service to conduct a status review. I am not qualified to evaluate the argument, nor is it germane to the Service's effort to gather "the best available scientific information" on the delta smelt.

Conclusion

The authors argue that the delta smelt should be removed from federal and state Endangered Species lists. To support this argument they reiterate their claims that (1) the population has been increasing for the past 15 years, (2) the population is larger than previously thought, and (3) given #1 and #2, the risk of extinction is small. There is no new information here and the reasoning is weak as well. As I discuss below the population has not been "increasing for 15 years" but even if it had been, an increase would not necessarily mean that the population is out of danger. Similarly, if the population were larger than previously thought, it would not would that mean the threat to the species was *substantially* less than previously thought. As I have already written, the threats facing the Delta smelt population are numerous, large and, in many cases, not at all related to the species' population size. Finally, the evaluation of risk to the species cannot be accurate since (a) the inputs are not accurate, and (b) in numerous one-year periods, the delta smelt population declined perilously close to extinction (for example, the 1981, 1994, and 1996 abundance estimates) from levels that are much higher than current estimates. Given the delta smelt's one year life cycle, a similar decline in abundance is not only possible, it is likely under conditions that are common during a drought. A decline of similar magnitude to that which occurred between 1980 and 1981 or 1993 and 1994 or 1995 and 1996 could extirpate the delta smelt and, if not, would certainly place it in imminent danger of extinction.

Review of ***Trends in the fall midwater trawl abundance index for delta smelt*** *By B. Manly, W. Miller, and T. Hillman*

This paper claims to "examine the trend in the fall midwater trawl index based on data collected since the listing decision was made". This "examination" consists of fitting the data with several different "trend lines". No statistical analyses are presented making evaluation of "trends" impossible. Simply, the authors have drawn different lines through the data (using increasingly complex line-drawing algorithms) and then they have asserted that the delta smelt index has "trended" up for the past 15 years. Curiously, even their own lines do not support this conclusion.

Background

The first three paragraphs seem reasonably accurate but the information is not new. In the fourth paragraph, the authors state that the FMWT index is the "most important" measure of delta smelt abundance. There are several sampling programs that regularly detect delta smelt. Each of these provides valuable information. Although the relative merits of any of these sampling programs may be debated (and none of them are optimally designed to measure delta smelt abundance), the authors examine only the FMWT index. At the very least, they should acknowledge that the Suisun Marsh Survey's catches of delta smelt corroborate patterns detected by the FMWT in most years.

Conclusion

Again, I find it disconcerting that the authors place their conclusions before methods, results, or discussion. Worse though, their conclusion is incorrect and unsubstantiated – the FMWT delta smelt abundance index has both increased and decreased over the past 15 years. Abundance indices in recent years have been low by historical standards and the most recent "trend" (if there is one) has arguably been a decline.

Trends

The authors state "We used four generally accepted methods [for estimating trends in the FMWT index] to see if all four would produce the same results". This statement signals a serious problem with the authors approach. Why have the authors employed four different methods to establish a trend? One method (two

at most) ought to be most appropriate for these data and suffice for further analysis. Different line-drawing algorithms ought to show similar results when they are applied to the *exact same data*. Performing the line-drawing operation *on the same data* creates the false impression that there are several trends pointing in the same direction. In fact, *there is only one data set here.* Rather than draw several lines through these data, the authors should have attempted to *analyze the strength and significance* of any "trends" produced by any *one* line. This basic statistical analysis is completely absent. Instead, it appears that the authors have (1) drawn several different lines through the data and then (2) looked at an arbitrary starting point (the mid-1980's lows) and the most recent three years of data and then (3) drawn a straight line between the 1980's lows and the current abundance estimates. Why bother using "linear splines smoothing" or a complex polynomial if you are not going to (a) analyze the strength of the relationship statistically, or even (b) look at the actual lines these methods actually produce?

Even if the authors had actually analyzed the results of their line-drawing exercises, I would question the techniques they employed. For example, the 5-year moving average of delta smelt abundance would not reveal that delta smelt had been completely extirpated even four years after the extirpation occurred. By "averaging" data from different years together, the five-year moving average (and, to differing extents, the Lowess and spline analyses) builds in temporal dependence into the data set that did not exist previously. Generally speaking, statisticians should seek to limit dependence among data points, not increase it. Indeed, when the authors employ line-drawing algorithms that minimize the number of years which contribute to "the trend line", their graphs show a declining "trend" over the last three years. Conversely, only the stiffest or most rigid lines (those where the influence of a single year registers over a very long section of the line) show a continuous increase in the abundance index. Figure 2, four of six panels in figure 3, and 3 of 4 panels in figure 4 (all of which use the same data) show that, over the past 15 years, the FMWT has both increased and decreased at different times. This directly contradicts the authors' assertion that populations have "shown an upward trend for approximately the last 15 years".

I must reiterate here that the authors have *not established any trend* because they have failed to *analyze the data* in any valid way that would establish a positive or negative population trend. Even if they had established a statistically, significant positive trend in the FMWT index, the rationale for, or estimate of, a population increase that would constitute a significant recovery of the delta smelt population is needed but absent.

Review of ***Estimating the population of sub-adult delta smelt*** *by W. Miller and A. Britton*

In this paper, the authors attempt to estimate current and historical delta smelt populations by correcting for the fall mid-water trawl's inefficiency at catching delta smelt. Throughout the paper, the authors repeat (like a mantra) that they "employ assumptions designed to produce conservatively low estimates" of delta smelt abundance. Actually, all of their assumptions are unsupported by the evidence and would tend to produce a high estimate of delta smelt population size. For example, they employ a putative relationship between the FMWT and another piece of gear, the Kodiak Trawl. However, there *is no statistically significant* correlation between the catches made by the FMWT and those made by the Kodiak trawl. In other words, any perceived relationship between the two gear types is not significantly different from *no* relationship. Thus, one cannot use historical FWMT catches to validly estimate what would have been caught had the Kodiak Trawl gear been used instead. The authors have ignored this fundamental principle of statistics and instead multiply historical FMWT catches by a large correction factor. This is completely and totally inappropriate. What is the point of using statistics if they can be thrown out willy-nilly for "computational simplicity?" The only reason they can even draw a "regression line" with an upward slope is because of a single point created by high catches with both gear types.

The authors then use their bogus estimates of what the Kodiak trawl would have caught (had it been used) and multiply these numbers by two constants to estimate the total population of delta smelt in the

Estuary. First, they assume that delta smelt were evenly distributed throughout the top 15 feet of the water column and multiply the estimated average Kodiak trawl catch-per-unit-effort by the volume of water in the top 15 feet of the Delta, Suisun Bay, and San Pablo Bay. There is absolutely no evidence to support this expansion of the, already highly speculative, estimated Kodiak trawl catches. Delta smelt are very surface oriented and they may not occur in large numbers below the top few feet of the water column. Indeed, the authors ignore the fact that the Kodiak trawl catches more fish than the FMWT because the former gear samples only the uppermost layer of the water column where delta smelt aggregate. The Kodiak trawl samples only the top 6 feet of the water column so there is *absolutely no data with which to estimate smelt abundance in waters deeper than 6 feet.* Furthermore, all of the fish caught by the Kodiak trawl might have occurred in much shallower water than the deepest water (ca. 6 feet) sampled by the net. If, for example, delta smelt are primarily found only in the top 6-12 inches of the water column, then the authors' estimate of delta smelt abundance would be reduced by a factor of 15-30x. The larger point is that, without additional study of the delta smelt's depth distribution and a more extensive Kodiak trawl data set, estimation of delta smelt populations based on estimated Kodiak trawl catches is speculative in the extreme.

The authors also assumed that the Kodiak trawl would have caught fish when the FMWT failed to catch fish. This speculation is based on the finding that, on 3 occasions in a side-by-side study, the Kodiak trawl caught fish when the FMWT did not catch fish. A sample size of three is far too small to justify the assumption that some number of fish existed in historical samples where none were detected by the FMWT. Also, as stated before, the regression equation the authors employ to convert FMWT catches to Kodiak trawl catches has *absolutely no statistical relevance.* But, even if it were statistically significant, the relationship between catches of the two nets is far too variable to allow accurate prediction of catches with one net based on catches by the other net. The authors have not even bothered to calculate confidence intervals on their (already too liberal) estimates. Had they incorporated the data variance into the estimates, the resultant error bars would undoubtedly have been huge.

The problems with their approach are also apparent when the spread sheets provided are examined closely. For example, in September, 1996 only one smelt was caught by the FMWT in Carquinez Strait and only one was caught in Suisun Bay. Yet the expanded estimate of smelt numbers is 684,000 for Carquinez Strait and 337,400 for Suisun Bay! Thus 37% of the 2.7 million estimated smelt are the result of a catch of 2 fish.

I firmly believe that the actual number of delta smelt in the San Francisco Estuary is far less than the number estimated by these authors. Despite the limitations of the FMWT index, these data are still quite valuable for assessing long-term trends in delta smelt abundance. First of all, the FMWT data set is largely corroborated by results of the Suisun Marsh Survey and CDFG's Bay Study—each of these monitoring programs reveal relatively low current abundance compared to historical values. Also, though the FMWT data will not allow precise calculation of delta smelt population size, comparison of index values from year-to-year is likely to be well correlated with delta smelt abundance. Finally, while the abundance of delta smelt is a valuable piece of information, the delta smelt will remain in severe jeopardy of extinction as long as the habitat in its very small geographic range is heavily modified by human activities and introduced species.

Review of ***Converting sub-adult delta smelt population estimates to estimates of adult population*** *by B. J. Miller.* The basis of this paper is that the estimates of smelt population abundance made in the previous paper were estimates of subadult populations and that this necessitates converting those numbers into the number of potentially spawning adults. Because the initial numbers used are not valid, as indicated above, the numbers of adults estimated in this paper are also not valid. In any case the conversion model used requires a number of simplified assumptions of delta smelt life history that increase the likelihood of error to the point where it is likely that even the model has little validity.

Review of "The Delta smelt and the state of the science," sponsored by San Luis and Delta-Mendota Water Authority and dated July 2002.

This paper suggests a strategy to improve one of the abundance indices for delta smelt, analyzes adjusted abundance data for trend, and presents an unsubstantiated conclusion from a separate, undocumented study (presumably quantitative modeling) on the risk of extinction for delta smelt. The authors then conclude that "The ... scientific knowledge base concerning delta smelt and the impacts of water exports on the Bay-Delta ecosystem present a compelling argument for removing the delta smelt from both California's and the U.S. government's threatened species list." This paper, however, does not compel this conclusion. The paper provides no description of the study of extinction risk (mentioned above) and no analyses of impacts from water exports on the ecosystem so the reader is left to take the associated results/conclusions on faith alone. Because of these and other critical flaws mentioned below, the paper is an exhortation, not a compelling argument.

The paper suggests a reasonable approach for analyzing midwater trawl data that should provide better insight into population status; however, it provides an inadequate argument for de-listing because it considers only a subset of the relevant information (e.g., only one of several indices [App. A, page 1, par. 3, lines 3-5] are mentioned or analyzed; and factors beyond abundance indices also must be evaluated in listing/de-listing deliberations). Furthermore, the paper does not describe or document the population viability analysis (PVA) which is critical to the final conclusion (page 1). A wide range of methods are available for population viability analysis, and a detailed description of the methodology is essential because suitability and reliability vary widely among methods.

The paper also suffers from various omissions. For example, it should compare the various abundance indicators for consistency, and should evaluate or document the impacts of water exports. The authors provide no evidence or discussion of how (or whether) it has been shown that "the routine curtailments of exports ... have little measurable benefits to delta smelt populations." Indeed, no evidence is presented to exclude the hypothesis that curtailments caused the recent increases in the delta smelt population.

Other deficiencies in the paper also are important. Although the abundance estimates used in the analysis (Page 3, par. 4 & 5, and App. B) are conservative relative to more extravagant estimates, the current estimates are not sufficiently conservative to dispel concerns about bias in the analysis. One wonders whether somewhat more conservative estimates, which would evoke less suspicion of bias, might have substantially altered the results. The analysis should have included additional scenarios to reflect the apparent uncertainty in the vertical distribution of smelt, uncertainty (high variance) in the relation of Kodiak trawl and midwater trawl catches, and uncertainty in the estimates of smelt density for tows where no smelt were captured. Various permutations of the analysis should explore the consequences from a range of alternative assumptions such as (*i*) all smelt occur within the upper six (or 10) feet of the water column; (*ii*) the relation between Kodiak and midwater trawl catches might be any one of the relations within the 90 or 95% confidence interval for the maximum likelihood relation; and (*iii*) the point (77.6,

0) on the surface for Kodiak- midwater catch (App. 2, Figure 2) is an outlier and should be omitted from the analysis.

The current analysis also suffers from inappropriate acknowledgement and response to the large "error" or "noise" associated with trawl catches. Recognition of the noise should have led to discussion of (*iii*) above, and geometric-mean (or comparable) regression to describe the relation between catches by Kodiak and mid-water trawls. The impact of such reasonable changes in the analysis must be known for one to reasonably judge the rigor or reliability of the conclusions. No doubt the authors agree that the regression analysis also suffers (though not critically) from insufficient data. Side-by-side comparisons should be conducted for more days, with additional explanatory variables included in the trials such as flow, temperature, total depth, salinity profile, or turbidity.

Another critical flaw in the paper is that no analytical or even conceptual attention is given to natural or anthropogenic variation in the system. For example, decadal-scale climatic cycling (vividly demonstrated in California by recent drought and wet periods with major effects on the Sacramento-San Joaquin delta) is widely recognized as a major ecological driver along the West Coast of North America and world wide, and is critically important for rigorous PVA. The paper provides no evidence that the PVA considered decadal-scale variation. Nor was there evidence that the biological consequences of remedial water export schedules or amounts were investigated. No mention of some key biological issues further leads me to question the adequacy of the viability analysis. Such issues include the large interannual variability in abundance expected for a nearly annual species in a dynamic environment, the possibility of severe density limitation during some periods (as suggested by alternating high and low populations during 1990-1997; Appendix A, Figure 1), and the certainty that drought will return.

In summary, this paper suggests the need for an updated status review for delta smelt, and presents a partial analysis to assist that process; however, the paper lacks sufficient scope and rigor to present a compelling argument that a designation of threatened is no longer warranted for the smelt.

Referee No._____

San Luis & Delta-Mendota Water Authority. 2002. The delta smelt and the state of the science: a white paper reviewing the 1993 listing of delta smelt as threatened and a review of recent science concerning the delta smelt. 5 pp + Appendices A, B, and C.

General Comments:

The white paper on delta smelt is succinct and clearly states the author's analytical approach and conclusions. I understand that such a white paper needs to be short and concise for managers and policy makers. The authors have chosen to place great weight in the estimated population levels. However, it is difficult to interpret the significance of these numbers without considering the life history characteristics of delta smelt or the trends in biological and environmental factors that determine delta smelt populations. The white paper has a fairly narrow scope and does not address determinants of delta smelt populations. The citation of scientific literature and technical reports to support the approach is generally lacking. Therefore, the document appears to be somewhat incomplete.

The fall midwater trawl surveys have been conducted for over 30 years and represent a valuable information resource. The trawling surveys were not originally designed as an index for delta smelt. The trawling was started to serve as an index for stripped bass. I believe the authors should have acknowledged that their use of the trawl survey data is not the original intended use. Furthermore, the use of the trawl survey data for an index is likely to be widely accepted while use of the data to calculate population estimates has many shortcomings and may not be accepted by the fisheries managers or researchers (Herbold 1996).

The "conclusion" section of the white paper contains conclusions not supported in the text of the paper or the attached appendices. For example, "The increase in the scientific knowledge base concerning delta smelt and the impacts of water exports on the Bay-Delta ecosystem present a compelling argument for removing delta smelt from both California's and the U.S. government's threatened species list." No analysis of the impacts of water exports on the ecosystem or delta smelt populations are cited or presented in the paper or appendices. Low delta smelt index values occurred in the early 1980's and relatively high entrainment rates occurred in 1981 concurrently with the El Nino conditions. A considerable database exists for pump sites where mortality and salvage records (Central Valley Project, State Water Project) are recorded for delta smelt, but an analysis of these data is not presented.

Comments on Appendix A:

This reviewer appreciated the author's efforts to provide information, figures, and data in the appendices describing trends, estimating the population of sub-adults, and converting estimates of sub-adult to adult populations. The analyses by Dr. B. Manly in Appendix A

are convincing that the "trend" has turned around. The authors notably omit any discussion of causal factors that might have caused the strong downward trend and the more recent increase in the delta smelt indices. Furthermore, The details on the estimated probability of extinction by year 2025 and 2050 are not adequately documented. Therefore, the conclusion "These estimates indicate there is essentially no chance that delta smelt would become extinct in the next half century" is not supported by this white paper. The modeling efforts of William A. Bennett, William J. Miller, and Wim Kimmer provide alternative modeling approaches, but no mention was made of these currently ongoing modeling efforts. Inasmuch as risk of extinction is central to this paper, the dismissive treatment is unfortunate.

During the past 30 years, when the trawl surveys were conducted to determine the delta smelt index, numerous factors such as introduction of exotics, water use, and development of the delta may have contributed to changes in the index. However, the white paper provides no insight to future trends in water use, human population growth, climate change, or other factors. For example, improvements in the management of the Environmental Water Account and improved fish screening technology (e.g., Tracy Test Facility) at water project pumps may improve survival at some locations in the delta. On the other hand, increased water exports or a decadal shift in regional temperatures could turn the trend downward in the future (see Hare and Francis 1994, Bennett and Moyle 1996). Given that we accept the trend in the index has reversed and has recently increased, the next question is, during the next decline in the delta smelt index how far will the index decline and how long will those conditions persist?

The appropriateness of considering causal factors when interpreting trends in the index, particularly low index values that might indicate risk of extinction, is borne out in the Recovery Plan (USFWS 1995) as well as the listing (USFWS 1993). The reasons for decline in order of importance were identified in the Recovery Plan as: 1) reduction in outflows of the Sacramento and San Joaquin rivers, 2) entrainment losses to water diversions, 3) high outflows, 4) changes in food organisms, 5) toxic substances, 6) disease, competition, and predation, and 7) loss of genetic integrity. Note that any of the first four reasons for decline of delta smelt could be worsened by decadal changes in weather patterns. The USFWS (1995) suggested two consecutive years of extreme flow in the Sacramento River could result in serious risk of extinction of delta smelt. This position may be reasonable given the life history characteristics of delta smelt. The short life span, approximately one year, and relatively low fecundity contributes to the risk of extinction if several years of extremely adverse environmental conditions occur.

Referee No._____

Comments on Appendix B:

This reviewer found four steps in the calculations in Appendix B: "Estimating the population of sub-adult delta smelt" where I believe the authors may have erred or may have omitted some

important assumptions. This may cast doubt on the population estimates. The issues are: 1) assumptions for expansion of density to population estimates, 2) regression of Kodiak trawl on fall midwater trawl density estimates, 3) scaling up zero values, and 4) correction factor of 0.25 for Kodiak trawl catch per unit volume. We thank the authors for providing adequate information to compute the total smelt in areas for the population estimates.

The first concern is the assumptions for the expansion of density data to population estimates are not stated explicitly. To make such expansions I believe the sampling design should have random station locations within areas (strata). The authors did not explicitly state these overall sampling design attributes. However, this reviewer believes that non-random station distribution (Sweetnam and Stevens 1993) is a concern for the approach used in this white paper.

The second concern is the units of the predicted values for the Kodiak trawl catch per unit volume from fall midwater trawl catch per unit volume. I did understand the application of the regression and agree that it is computationally easy to use the regression to make the correction. The sample size of the regression is only 12 paired tows so this correction factor is based on a very small sample size providing little confidence in this correction factor. The units in Appendix B Figure 2 for the Kodiak trawl and midwater trawl were "catch per 1000 m^3 . For delta smelt population estimates, table of adjustable parameters the volume thru the net is in "acre feet". The units are not equivalent as 1 acre ft = 1,234 m^3.

The third concern is the scaling up of zero midwater trawl catches. The approach was adequately described and I was able to identify stations scaled up and stations not scaled up. Stations with zero catch that were adjacent to stations with non-zero catches were scaled up using the regression adjustment. The authors reasoned that for some of the zero catches delta smelt were present, but were not caught because of the inefficiency of the fall midwater trawling method. A biologically reasonable alternative is that the fish were contagiously distributed, that is unevenly distributed, and zero catches really represent zero delta smelt present. The contagious distribution is often apparent in schooling fish that are pelagic and feed on zooplankton. Furthermore, delta smelt are most abundant in low-salinity water associated with the mixing zone in the estuary, and if that zone is located in Suisun Bay, then most frequently in shallow water (Moyle et al. 1992).

Referee No._____

The fourth concern is the use of the correction factor of 0.25 applied to the Kodiak trawl catch per unit volume. The need for this correction factor is either not adequately explained so this reviewer could understand or the correction factor is redundant. The fall midwater trawl catch in fish per 1,000 m^3 was used to predict the catch by the Kodiak trawl. The fall midwater trawl catch per 1,000 m^3 was based on oblique tows from bottom to surface, and therefore, the catch per unit volume is representative of all depths. The regression equation shown in Appendix B, Figure 2 is used to correct the catch per unit volume of the fall midwater trawl directly to estimated catch per unit volume of the Kodiak trawl. If the correction factor of 0.25 is used in addition to the regression correction I believe it is redundant.

References

Bennett, W.A., and P.B. Moyle. 1996. Where have all the fishes gone? Interactive factors producing fish declines in the Sacramento-San Joaquin estuary. Pages 519-542 In J.T. Hollibaugh (ed.) San Francisco Bay: the ecosystem. Pacific Division, American Association for the Advancement of Science, San Francisco, California.

Hare, S.R. and R.C. Francis. 1994. Climate change and salmon production in the Northeast Pacific Ocean, Pages 357-372. In R.J. Beamish (ed.) Climate change and northern fish populations. Can Spec. Publ. Fish. Aquat. Sci. 121.

Herbold, B. 1996. Why we don't do population estimates for delta smelt. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Spring 1996.

Moyle, P.B., B. Herbold, D.E. Stevens, and L.W. Miller. 1992. Life History and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 121:67-77.

Sweetnam, D.A. and D.E. Stevens. 1993. Report to the Fish and Game Commission: A status review of delta smelt (Hypomesus transpacificus) in California. California Department of Fish and Game. Candidate species status report 93-DS.

USFWS (U.S. Fish and Wildlife Service). 1995. Sacramento-San-Joaquin Delta Native Fishes Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS (U.S. Fish and Wildlife Service). 1993. Endangered and threatended wildlife and plants: Determination of threatened status for the delta smelt. Federal register 58 (42): 12854-12864.

General comments:

The authors conducted an analysis to examine the state of the science in connection with the status of delta smelt, which is a listed species under the Endangered Species Act. The review of this paper is made difficult, because in my opinion the authors do not follow any standard scientific protocol used in peer reviewed journals. This paper lacks solid organization, which should identify the specific problems being addressed, clearly identify the authors' hypotheses, explicitly describe the methods they are using to test hypotheses, report and discuss results in a manner that can be repeated by other scientists, and lastly synthesize their findings with a thorough review of the literature on smelt biology, population dynamics, and conservation biology. I believe, from an organizational standpoint, this paper could be greatly improved if it was consolidated and followed the categories of topics I outlined in the previous sentence. I realize the purpose of this paper was not for publication; however the standard for good science should still be applied to this situation. In my opinion the objectives need to be clearly stated, the data and the methods clearly identified, the results repeatable, and the discussion placed in full context of the issues with thorough references to the prevailing literature on the subject. I will describe the specifics of these short comings below.

I feel another significant short coming of this paper was that the authors evaluated the trend of an abundance index for only one of the life stages available for delta smelt. There was no context provided from an ecological perspective that rationalized the author's use of only the autumn mid-water trawl. Moyle et al. (1992) were concerned that the autumn abundance indices may reflect the fact that the population has been confined to a restricted area where fish are concentrated. The summer tow net abundance index is believed to be one of the more representative indices, since the data has been collected over a wide geographic area for a long period of time (Federal Register Vol. 8, No.52, March 5, 1993). The authors concluded that the data show an increasing trend in smelt abundance since the mid 1980s, using a limited time series and only one life-stage abundance index.

I would recommend that the authors evaluate the population trend for a number of the available abundance indices and for the full time series of data. I believe comparison of the trends from the various indices and evaluating them over differing time series would increase the confidence in detecting a change in the population trajectory. For example, evaluating the trend in autumn index smelt abundance by fitting a simple linear model over the entire time series of data, yields a declining trend that is significant at p=0.05 level. The authors characterization of the population trend increasing (from autumn indices) appears misleading, because one could alternatively look at the 60% drop from 1970-1973 average to the present (1999-2002 average) or the 33% drop from the 1970-1980 average to the present. I would recommend an evaluation that looks at the trend over the longest time series, similar to estimating the population growth rate (lambda) (Gotelli 1998). In fact, my estimate of lambda for this population (using the autumn abundance indices supplied in the spread sheet we were given) is 0.975, a negative population growth rate. In order to capture a wide range of environmental conditions and provide a robust analysis, I believe the authors should use the longest time series of data that is available.

In the main paper the authors have two conclusion sections, which is highly irregular and confusing to me. The first set of conclusions address recent studies that posit an increasing trend

in smelt abundance, estimate total abundance for sub-adult smelt, and estimate a probability of extinction for delta smelt. The authors then state that the US Fish and Wildlife Service has not conducted these specific analyses. However, the authors at this point do not conclude why this is a problem relative to evaluating the status of delta smelt. The second set of conclusions claim that *the increase in scientific knowledge concerning delta smelt and impacts of water exports on the ecosystem present compelling arguments for removing delta smelt from the threatened species list.*

I found that in addition to some of the technical problems with the authors methodologies (see details below), two major components where missing. First, they did not present analyses or provide any reference or references that evaluated the impacts of water exports on the Bay-Delta ecosystem as it relates to delta smelt status. Therefore, I feel the authors' do not supply any supporting material for their claim: '*that since 1996 significant new information concerning... the impacts of water exports on fish populations have been developed (*page 4, paragraph 4)'. There are a number of publications that establish the impacts of water exports on fish (Moyle et al. 1992, Meng et al. 1994, Stevens 1977, and Stevens et al. 1983). The authors provide no analyses, references for new information, or rationale to counter these previous findings. Secondly, the authors present results on estimating the extinction probabilities for delta smelt without presenting the methodology. I could not find a description of the methods used for estimating extinction probabilities in the main report or in any of the appendices. In fact, there were no references to any methods applied to estimate extinction probabilities. In order for the estimates of extinction probabilities to be evaluated I recommend the authors present the model or models used, describe how the population growth rates are estimated, the initial population size, the quasi extinction level used, and the variance about those parameters. In addition, in order to evaluate the robustness if the extinction probabilities a sensitivity analysis of extinction probability estimates to the various assumptions concerning model selection, model parameters, and the variance about those parameters would be required.

Appendix A:

The authors use four methods to analyze the trend in trawl abundance. However, they never state the hypotheses they are evaluating. It is unclear what time series they are trying to assess the trend over. There are no statistical tests used to determine a positive or negative trend and no explanation of the significance or power of the authors' results. The author's draw conclusions based on a visual examination of graphs for the various transformed trawl indices. The authors' did not provide a rationale for why they chose visual inspection over the application of a statistical test. There is no explanation given for why they selected to visually inspect a limited time series of the data. I feel this is an arbitrary approach to assess population trends. I would recommend a simple approach of evaluating the linear trend of the full time series of trawl surveys with regression techniques or the log transformed survey indices.

Appendix B:

The authors' attempt to estimate total abundance of the delta smelt population for 1996-1999. The estimates for abundance from trawl indices appear to me to be highly uncertain. I believe the authors would need to look at the sensitivity of abundance estimates for a number of key

assumptions. For example, applying the point estimates from the regression of mid-water trawl to Kodiak trawl estimates would greatly underestimate the confidence bounds for the population estimates. The regression analysis presented in figure 2 appears to be strongly influenced by a single value (0.6 mid-water trawl value –without this point r^2 drops to 0.0038). In addition, the estimates need to be made for the entire time series to understand the changes in population abundance. Lastly, the adjustment of the zero values for mid-water trawl samples appears arbitrary. I believe before attempting an adjustment to cells having zero values an assessment needs to be made to test for a contagious distribution of trawl values among sampling cells.

Appendix C:

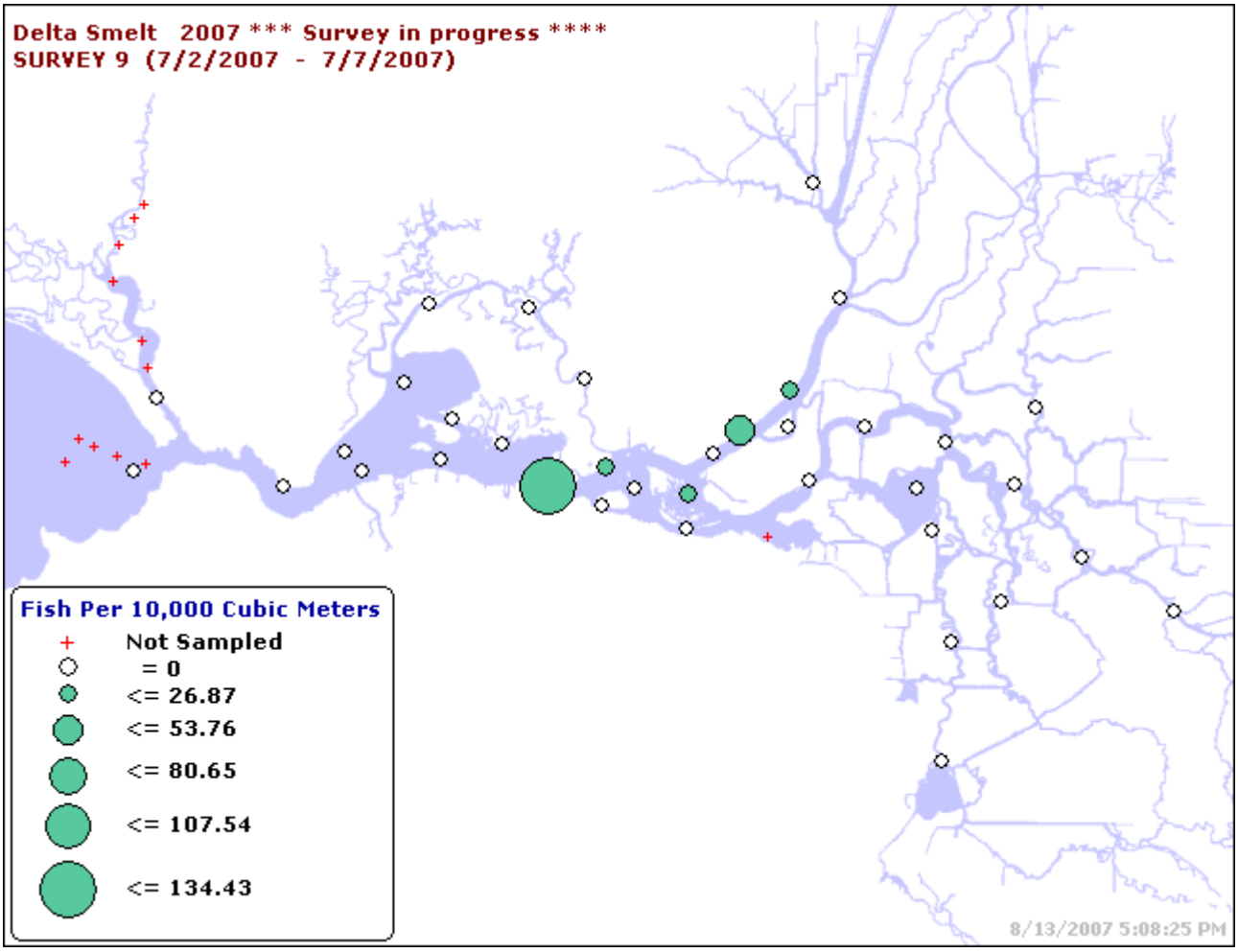
The author attempts to enhance the estimates of abundance in appendix B to account for only the sexually mature portion of the delta smelt population. The uncertainty in these estimates increases, because of the fact that there are additional assumptions applied to the estimates of appendix B. Again, I believe the authors would need to look at the sensitivity of total abundance estimates to a number of key assumptions and also the addition of assumptions used to estimate the mature portion of the population. In particular, I am concerned about assuming all delta smelt reach adult life stage precisely on March 31 given the range of spawning time for this population.

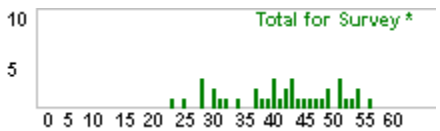
In summary, I believe this report does not layout clear objectives and is poorly organized. The techniques used to analyze the data are ambiguous and lacking in rigor. The authors' do not rationalize their findings with either biological or ecological explanation. I feel that there was little review of the existing literature on either delta smelt ecology or analytical techniques for determining the status of threatened species. I did not find a single reference to any conservation biology literature. I would not characterize any of the techniques used to be cutting edge science. The authors did not discuss or directly challenge any of the alternative views existing in the literature regarding the relationship of delta smelt status to the ecology and threats imposed upon this population. The authors presented limited and questionable information on the population trend of delta smelt, population abundance, and extinction probabilities, which they believe warrants a change in status of the delta smelt population. However, they do not present any information on how the threats to the population has been removed or alleviated, which was key component of the five factor analysis used for listing this population (Federal Register Vol. 8, No.52, March 5, 1993). In short, I believe the authors would need to completely revamp their manuscript in order for these findings to be acceptable in a professional fisheries journal.

EXHIBIT 2

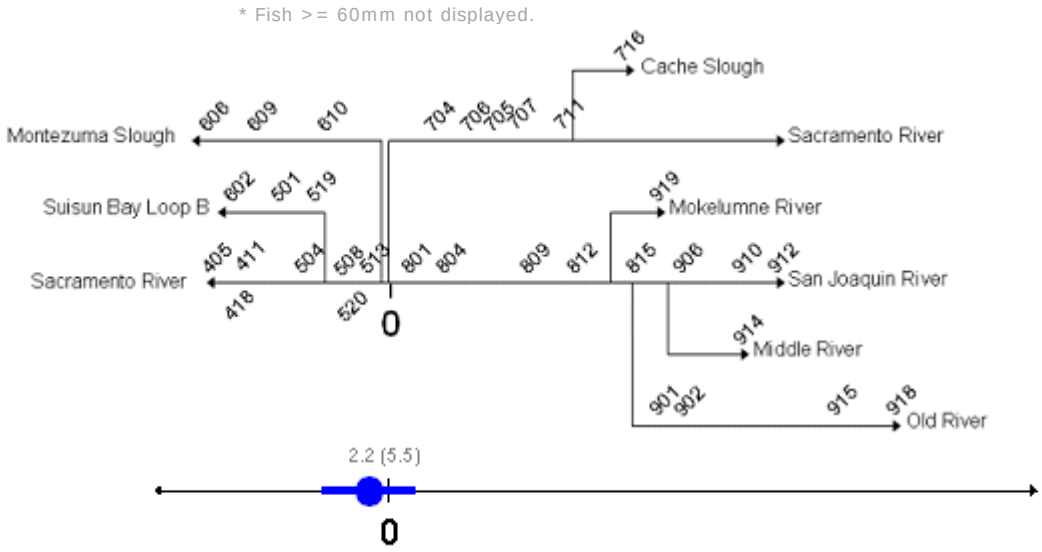
SELECT SPECIES	YEAR	SURVEY	View Station ID:	Optional Max Value : Values less than actual maximum will be ignored.
Delta Smelt		9		Draw Map

Data Table Below Map





Click on a station's catch to view it's length/freq chart.



Delta Smelt 2007 Survey: 9

STATION	SURFACE TEMP	SURFACE EC	NUMBER OF TOWS	AVERAGE CPUE
323	18.6	34360	3	0
340	19.5	26640	3	0
405	19.9	18500	3	0
411	20.7	20240	3	0
418	20.5	19300	3	0
501	21.3	12820	3	0
504	21.6	11280	3	0
508	22.1	3533	3	134.43
513	22.0	2611	3	22.14
519	22.1	6580	3	0
520	22.8	1474	3	0
602	22.9	10290	3	0
606	23.9	10470	3	0
609	22.6	7480	3	0
610	22.7	5910	3	0
703	22.3	841	3	3.64
704	21.9	1677	3	0
705	21.8	249	3	0

706	21.4	425	3	31.59
707	21.7	190	3	3.87
711	22.0	179	3	0
716	21.8	215	2	0
801	22.3	2499	3	0
804	23.6	690	3	0
809	21.1	786	3	0
812	21.7	324	3	0
815	21.6	256	3	0
901	21.0	396	3	0
902	22.2	315	3	0
906	22.2	232	3	0
910	25.2	571	3	0
912	25.6	621	3	0
914	24.7	346	3	0
915	23.4	316	3	0
918	23.6	337	3	0
919	21.9	189	3	0

[View Map]

Back to Top of Page

EXHIBIT 3

Delta Smelt Working Group Conference Call Minutes

November 28, 2005

Participating: Gonzalo Castillo (USFWS), Mike Chotkowski (USBR), Kevin Fleming (CDFG), Lenny Grimaldo (CDWR), Bruce Herbold (USEPA), Tracy Hinojosa (CDWR), Peter Johnsen (USFWS), Ann Lubas-Williams (USBR), Matt Nobriga (CDWR), Ryan Olah (USFWS) and Victoria Poage (USFWS, convener and scribe)

For Discussion:
1. Prioritize potential WY 2006 fish actions.
2. Discuss potential winter fish action scenarios.
3. Schedule an in-person meeting for later in the week.

Handouts:
1. Winter salvage slides (Mike Chotkowski)
2. Winter salvage slides (Kevin Fleming)

Recommendations for WOMT:
None at this time.

The DSWG prioritized potential WY 2006 fish actions using environmental water from highest to lowest, as follows:

1. winter action to protect adult delta smelt
2. early-spring action to protect larvae
3. spring action to protect larvae and post-larvae
4. late-spring action to protect larvae and post-larvae
5. early-summer action to protect post-larvae and juveniles

It was understood by the DSWG that EWA assets would not be used to support Delta Action 8 in WY 2006; however, b(2) water could be used for DA8. The DSWG believed that use of all available environmental water assets for a winter action would be imprudent, particularly in a dry year, as it would leave virtually no assets to use for the protection of larvae and post-larvae in the spring, should that prove necessary.

Mike Chotkowski and Kevin Fleming provided preliminary analyses to the group via e-mail. In most years, winter salvage occurs as one continuous event spread over time. In wetter years, salvage begins abruptly while in drier years, salvage accumulates more gradually. There appears to be a co-occurrence of flow increases and salvage at the facilities, but not much lead time. It may be that fish are responding to changes in flow; however, reasonable criteria are needed for determining the beginning of a flow change and a salvage event. Kevin's analysis appears to indicate that salvage events occur following combined San Joaquin and Sacramento River flows of about 30,000 cfs. It may be appropriate to devise preliminary recommendations for "wetter" and for "drier" years, with the delineator at 25,000 to 30,000 cfs at Freeport. Further analysis of existing data is needed before recommendations can be made.

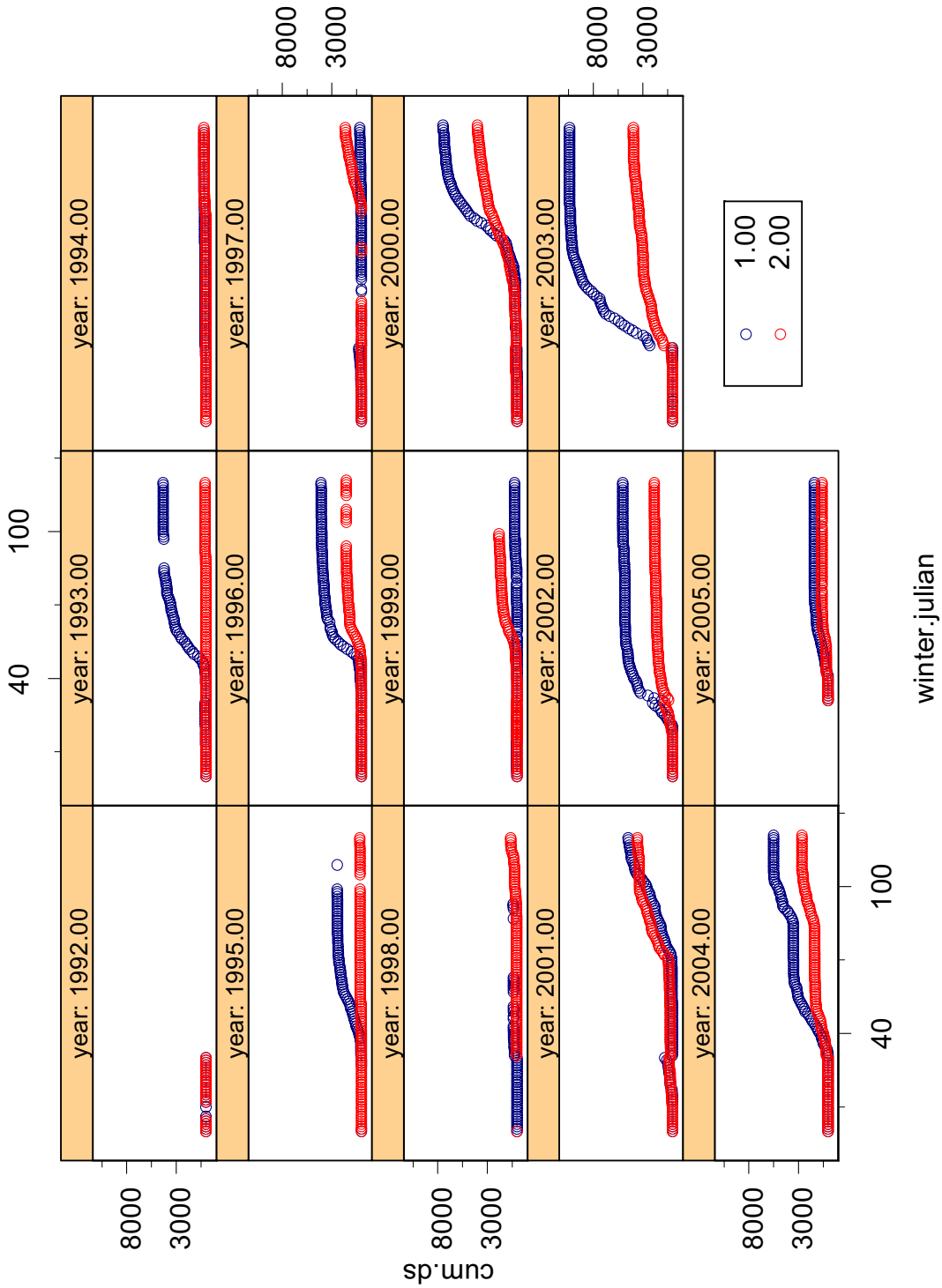
Action items:

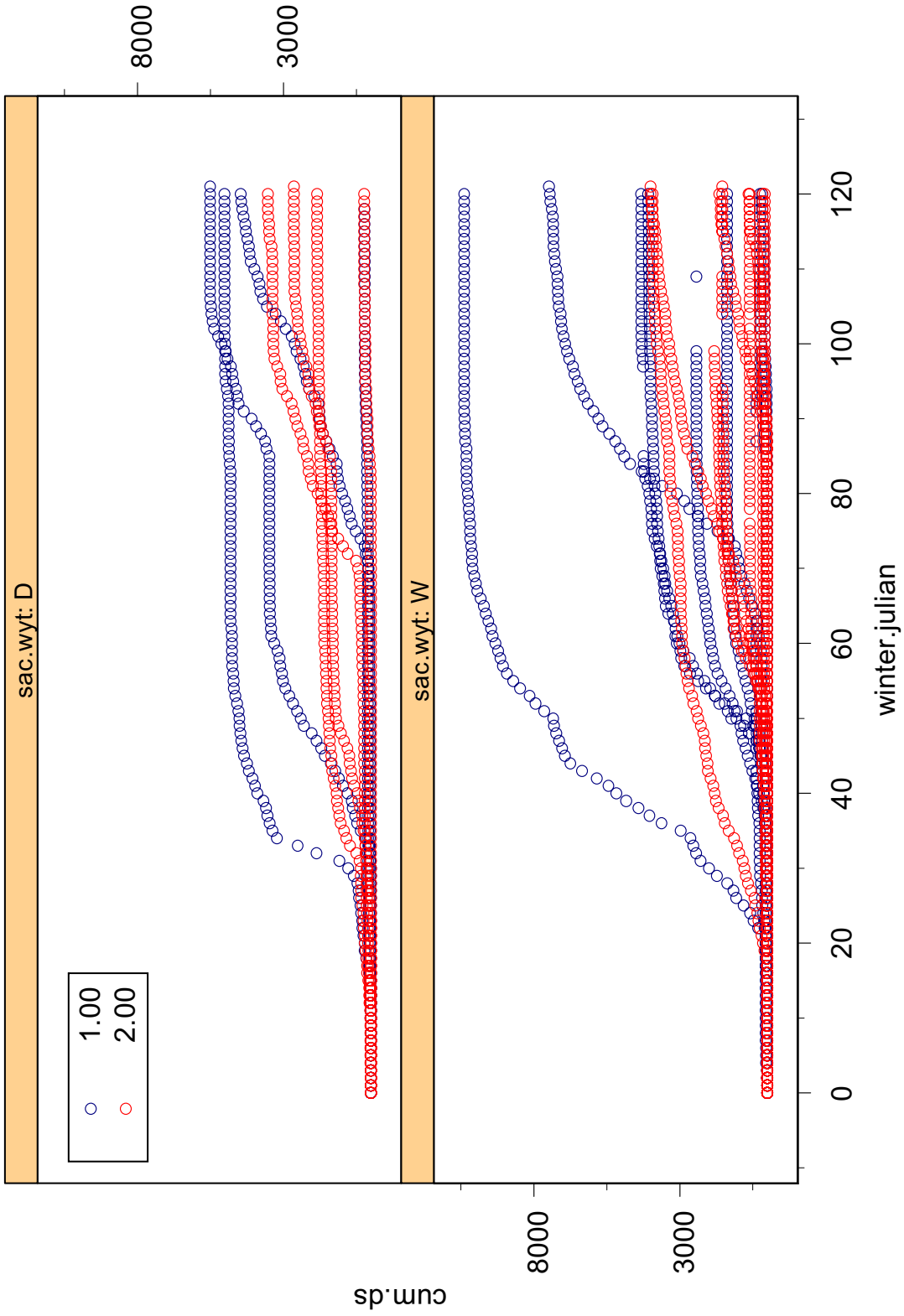
1. Bruce Herbold and Jim White will bring up the use of b(2) water for delta smelt with the b(2) IT and provide feedback to the DSWG.
2. Mike Chotkowski and Kevin Fleming will re-examine the data to attempt to:
    a. identify appropriate criteria for determining changes in flow and the onset of a salvage event
    b. find cues in salvage densities
3. Ann Lubas-Williams or Tracy Hinojosa will bring long-range operational forecasts to the next meeting.

Next meeting:
Monday, December 5, 3:00 pm in the large conference room at DES (subsequently changed to Friday, December 9 at 3:00 pm, same venue).

Attachments: 2

Submitted,
VLP


year: 1992.00
year: 1993.00
year: 1994.00
year: 1995.00
year: 1996.00
year: 1997.00
year: 1998.00
year: 1999.00
year: 2000.00
year: 2001.00
year: 2002.00
year: 2003.00
year: 2004.00
year: 2005.00
cum.ds
8000
3000
40
100
winter.julian
1.00
2.00


sac.wyt: D
sac.wyt: W
1.00
2.00
cum.ds
8000
3000
0
20
40
60
80
100
120
winter.julian

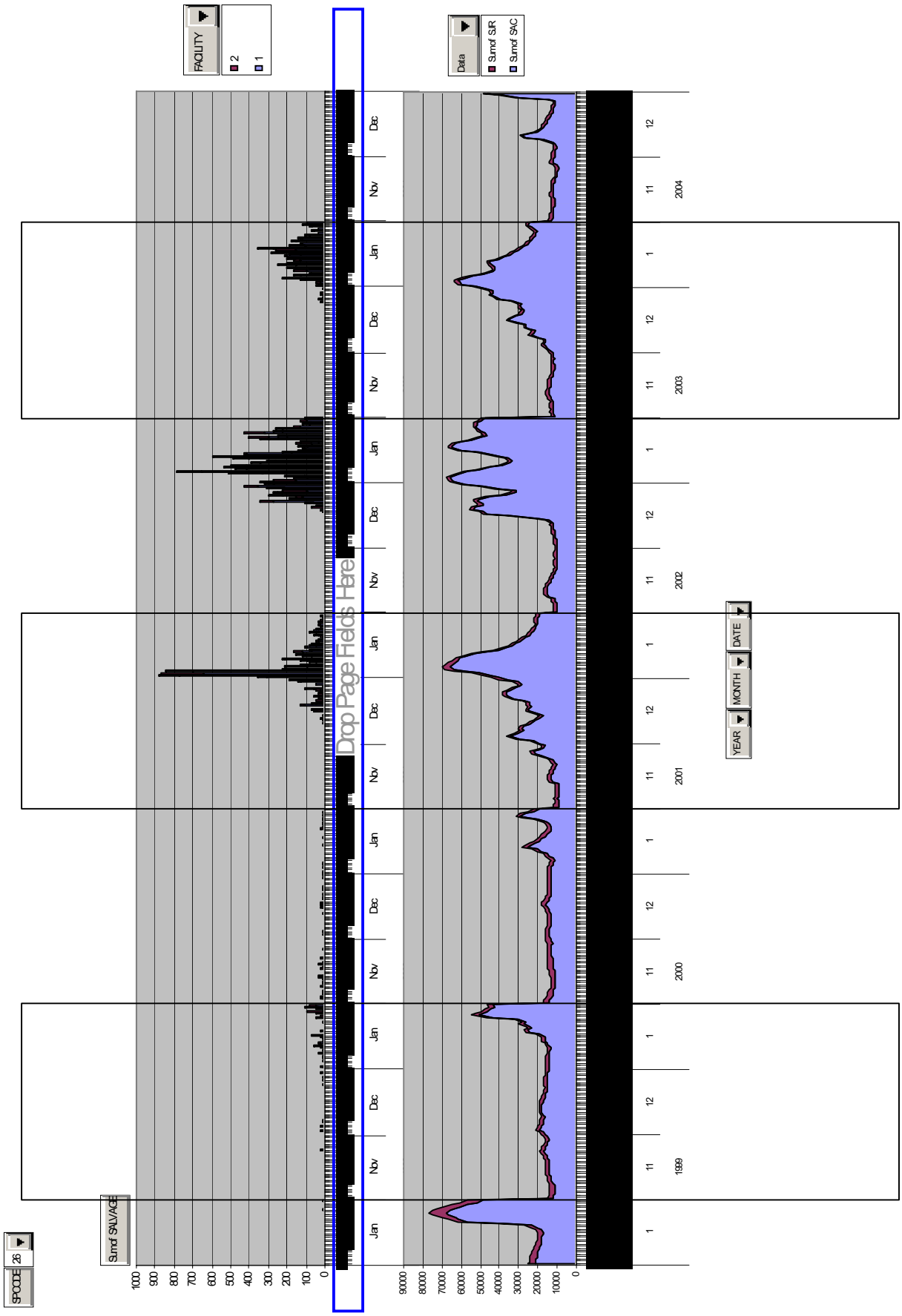

FACILITY
2
1
Data
Sumof SJR
Sumof SAC
Drop Page Fields Here
YEAR
MONTH
DATE
SPECIE
26
Sumof SALVAGE
Jan
Dec
Nov
2004
2003
2002
2001
2000
1999
1000
900
800
700
600
500
400
300
200
100
0
90000
80000
70000
60000
50000
40000
30000
20000
10000
0

EXHIBIT 4

Review of the 2006

Environmental Water Account (EWA)

Submitted by the

EWA Technical Review Panel

January 2007

To

Dr. Michael Healey
Lead Scientist
California Bay-Delta Authority

Executive Summary

The Environmental Water Account (EWA) Technical Review Panel convened at a workshop on November 28-30, 2006 in Sacramento, California. The Panel was impressed with the noticeable improvement in the quality of the presentations, and the obvious increase in the analytical work that went into the preparation for the workshop. This positive statement has two caveats. First, there is still substantial scope for improving the relevance and efficacy of the EWA, and we offer a number of recommendations intended to help the program continue to improve. Second, the Panel believes that the improvements in the 2006 review were largely the result of the additional funds made available through Pelagic Organism Decline (POD), which reinforces the Panel's recommendations in previous reports that increased funding for research and monitoring was needed and would be beneficial.

The Panel believes that EWA, after a slow start, has accumulated enough information (due in part to the POD effort), to now develop an effective program. Some of our recommendations (e.g., conducting a new gaming exercise) would use this accumulated information to date to refine and strengthen EWA as it goes into the future.

In the following sections of the Executive Summary, we summarize our consensus on the strengths, weaknesses, and recommendations. These are discussed in more detail below in the main body of this report.

Strengths

- The EWA Program continues to assure reliability of water supplies to water users.
- The EWA staff incorporated new decision tools in response to inter-annual and intra-annual changes in water conditions.

- The public is included in the full range of EWA activities.
- CALFED increased funding for research on EWA issues.
- CALFED workshops and seminars disseminate information and help link research to management.
- The EWA is subjected to a multi-tiered review structure.
- Statistical analyses have improved since the last EWA panel review.
- The scientific approach in several on-going projects discussed at the November 28-30 review has improved since the last review.
- The exploratory studies about fish ecology and the use of numerical models, triggered by the POD, are a positive addition to the EWA.

Weaknesses

- The EWA Program lacks measurable performance measures.
- EWA is not integrated into the overall scheme of water management in the system.
- A reduction in the amount of EWA water, and apparent modification or rejection of EWA recommendations, can quickly compromise the value of an EWA program.
- There is not enough water presently committed to EWA to simultaneously manage habitat and water quality, route salmon through the system, and make delta smelt less vulnerable to export pumping.
- A systematic approach is lacking that would allow evaluation of how EWA actions intended to improve conditions for one species may be detrimental to other species of concern.
- Current monitoring is not adequate to determine the effects of EWA on populations of species of concern.
- Identifying the importance of EWA as a factor influencing populations of key species will be difficult because of the small amount of water in the EWA and the large variability in the hydrologic environment that influences the distributions and dynamics of species of concern.
- Hydrographic changes due to climate, consumptive water uses, and water storage are affecting water availability differentially in the Sacramento versus San Joaquin drainage basins. These factors appear to make water management options much less flexible in the San Joaquin side of the system.
- Changes in upstream water use, particularly in the San Joaquin basin, have resulted in a slow and steady change in salinity patterns in the south Delta, especially in the fall. As such, the system is likely being “pressed” towards decreasing habitat quality that could hinder the operation of the EWA.
- Even though the Panel recognizes recent improvements in statistical analysis, additional improvement is needed.
- Real integration of all the sources of environmental water is lacking.
- Other programs, such as Vernalis Adaptive Management Program **(**VAMP), are not subjected to the same level of peer review as the EWA Program.

- In recent years there has been a disconnect between the size of the EWA Program and the expectation that EWA should contribute to species recovery.
- Staff and funding for EWA related research and analysis is diffuse and too small.

Recommendations

- The Panel continues to recommend that research funds be earmarked directly to address EWA issues, and encourages a concerted effort to incorporate the results of the new research into EWA actions and management.
- The Panel encourages the continued use of workshops to address specific topics and issues related to EWA.
- The Panel recommends more use of web-linked documents in reviews. These could supplement the PowerPoint presentations with background information such as the proposals and work plans of projects presented in the reviews.
- The multi-tiered review structure is important and the Panel supports the continuation of reviews of EWA on a bi-yearly basis. The EWA review process should serve as a template for other programs such as the VAMP.
- The Panel encourages continued and expanded use of internal and external statistical consultants.
- Panel encourages the further application of particle tracking models to understand the movement of delta smelt at junctions and to understand the effects of the Head of the Old River Barrier (HORB) on the routing of pelagic organisms and salmonids through the Delta. However, conclusions drawn from the particle tracking experiments are contingent on the assumption that delta smelt move like neutrally-buoyant particles. The panel encourages further studies to understand the effects of life-stage-specific behaviors on the transport of delta smelt throughout the Delta and the effect of exports on their distribution.
- The Panel encourages consideration of the behavioral responses of fishes to hydrologic and water quality signals in connection with the study of junctions and other hydraulic and landscape features in the Delta. The Panel also encourages studies to understand the hydraulic and salinity cues that mediate the spatio-temporal distribution of delta smelt and their entrainment into the pumps.
- The Panel encourages the development of models that estimate the indirect routing effects of exports. The impacts resulting from the routing of fish into regions of the Delta that are favorable or unfavorable to growth and survival of particular life history stages need to be better quantified.
- As in past Panel reports, the magnitude of the indirect effects of the pumps via mortality multipliers (e.g., as used for Clifton Court Forebay) are important to quantifying entrainment effects but still remain unconfirmed.
- Programs such as VAMP should apply mechanistic life cycle approaches that identify factors affecting routing and survival of salmonids through the San Joaquin River and the Delta. In particular, the Panel encourages a mechanistic approach to understand

the effects of the HORB on Delta dynamics and on the survival of San Joaquin salmonids.

- The panel encourages the development of general EWA performance measures and specific EWA performance measures that are linked to critical life stages of the salmonid and pelagic organisms of the Delta.
- Results of the ongoing research should be used to refine the decision support tools. Changing environmental conditions and greater demands on a potentially shrinking supply of environmental water suggests that the water programs would benefit if they were combined into a single coordinated operation and assessment program. The Panel believes that only through a coordinated environmental water program can efficient trade-offs of water allocations be achieved between tributaries and the Delta and across anadromous and resident species**.**
- The panel encourages completion of studies such as Marston and Mesick, Herbold, Swanson, and Miller and, where appropriate, submissions to a peer reviewed journal such as the San Francisco Estuary and Watershed Science, fish ecology journals, and the journal Endangered Species Research (Inter-Research).
- It is important to view all EWA actions in light of the full range of their potential effects on the multiple species of concern, rather than their effects on single species. To maximize the effectiveness of EWA water, it may be necessary to identify tradeoffs associated with actions that benefit one species at the expenses of others. This may ultimately lead to prioritization of actions based upon the relative risk of jeopardy among species at-risk.
- Both winter run Chinook salmon and delta smelt would benefit if the water exported at the pumps was derived mostly or entirely from the San Joaquin River; thus resulting in positive flows in the Old and Middle Rivers. Such actions would, however, have to be weighed against the potential negative impacts on San Joaquin salmon runs of the increased use of San Joaquin water.
- It may be necessary to re-engineer the system to maximize the potential for export of San Joaquin River water before it reaches the Delta. This may not be possible if San Joaquin flows are insufficient under the current management regime to satisfy the water volume needs at the pumps.
- The Panel believes that knowledge of cause and effect may be enhanced by increased flexibility in the methods and locations of data collection, including new studies and monitoring specifically designed to address process-level questions.
- We are recommending new studies, both descriptive and experimental, that are informed by the new information gained as a consequence of the POD efforts. If no new EWA-specific sources of funding can be obtained for this purpose, it may be efficacious to dedicate a small portion of the EWA funds now used for buying water to new studies, despite the aforementioned problem of decreasing trends in the amount of EWA water. In the long term, this maybe a good trade-off for improving the efficiency of the EWA.
- While the Panel recognizes the improvement in statistical analysis demonstrated at the 2006 review, there is still a need to improve statistical rigor and discipline in data analysis. Further attempts at data mining that is not hypothesis driven is discouraged. Group collaboration is needed to resolve the apparent discrepancies in conclusions

reached by different people seemingly analyzing the same data using similar techniques.

- There are several ways to improve the quality of data collected relative to its quantity, and the recommendations of the Panel fall into three general areas:
    1. Focus on needs identified during development of population models to elucidate cause and effect, and to inform the models;
    2. Narrow the questions attempting to be addressed and focus on the factors affecting the distribution and abundance of all life stages of delta smelt in space and time, including delineation of spawning habitat. Many of these questions can be addressed by amending the existing sampling programs. However, keep in mind that sampling stations used for multiple purposes can compromise their value;
    3. Determine to what extent the lack of understanding and quantification of gear efficiencies can mask relationships, inflate uncertainty, and preclude defensible estimates of population size based upon the monitoring results.
- Suggested areas for new research include but are not limited to: behavior of fish in responses to flow; improvements in monitoring in real time; genetics studies for better identification of members of specific salmon runs; estimation of mortality of delta smelt and salmon smolts in the Delta, in the Clifton Court Forebay, and in the pumping facilities; and accurate estimates of entrainment (including indirect effects) of all at-risk species and life stages.
- The Panel endorses the idea of viewing environmental water from all sources together as a common pool. We encourage efforts to waive or remove, as much as possible, institutional barriers that hinder the pooling of environmental water from among the different sources.
- In a future environmental water program, either aiding recovery is a goal and sufficient water is allocated to achieve it, or the goal should be revised so expectations are compatible with the amount of water made available.
- A fish life cycle approach should be the cornerstone for a future environmental water program.
- Dedicated staff and funding is the most efficient way to achieve the level of quantitative analyses needed in a future environmental water program. A future environmental water program should also have the resources to support research and analysis of its specific questions and issues. Examples of EWA-centric analyses include, but are not limited to, population estimation from monitoring data, what to do in wet years (given that recent wet years did not benefit fish as expected), statistical analysis of data on spatio-temporal distributions of life stages and mortality rates, trade-offs between upstream and downstream actions and among multiple species, and the likely effects of climate change.
- It is time to revisit gaming to help size and “optimize” the mix of actions under different conditions (e.g., wet versus dry years) in a future environmental water program. A new gaming exercise should also include biological life-cycle models that were not available ten years ago.

Introduction

The EWA Technical review Panel (members listed in Appendix 1) convened at a workshop on November 28-30, 2006 in Sacramento California[1]. As in past years, the panel was charged with the preparation of a report that provides "… a comprehensive evaluation of the EWA to determine the biological benefits of EWA and other environmental water in recovery of at-risk native species and provide recommendations on water allocation priorities…." Within this context, there were seven specific questions in the charge to the Panel and we considered these in preparing this report.

Following the public presentations at the November 28-30 workshop, the Panel met to discuss the results of the workshop and to draft a preliminary set of findings. Dr. Kenny Rose presented those findings to the meeting participants on the morning of November 30, 2006. After the presentation, there was a lengthy and informative discussion between Panel members and the audience. The presentations and the discussions during the workshop and after the preliminary presentation of Panel findings were considered in the Panel's responses to the seven questions stated in our charge.

The Panel wishes to acknowledge the hard work and dedication of everyone who contributed to the workshop. We realize the workshop was a major undertaking and want to thank all of the presenters and participants for their efforts. We also wish to acknowledge that the technical quality of the presentations in this year's workshop was noticeably improved over past workshops. This positive statement has two caveats. First, there is substantial scope for improving the relevance and efficacy of the EWA, and we offer a number of recommendations intended to help the program continue to improve.

[1] Dr. Paul Smith of the EWA Review Panel was unable to attend the November 28-30 workshop in Sacramento.

Second, the Panel believes the improvements in the 2006 review were largely the result of the additional funds made available through Pelagic Organism Decline (POD), which reinforces the Panel's recommendations in previous reports that increased funding for research and monitoring was needed and would be beneficial.

This year's report is organized as follows: In the first section we present the many positive findings and accomplishments of the EWA program. The second section addresses the seven questions in our charge. In both sections, we offer suggestions for improvement in the implementation of the EWA[2]. Our recommendations are highlighted in bold in the text of the report and also listed in the Executive Summary.

Positive Findings for 2006

In its sixth year, the Environmental Water Account (EWA) program demonstrated continued improvement and progress. Notable accomplishments are listed below:

Water Supply Reliability

As in the past, the EWA program has assured reliability in water supplies at no cost to the water users; and, as noted in other reviews, efforts have continued to creatively diversify resources, and to develop models of acquisition, storage, and debt.. The real-time allocation of EWA and (b)(2) water is a complex, but for the most part, efficient process that has steadily improved over the life of the EWA program. The EWA staff demonstrated its ability to incorporate new decision tools and information and to

[2] The reader should be aware that several recommendations by the Panel center on the full life cycle approach, which can include, but does not necessarily have to include, numerical population models. Several members of the review panel have funding from CALFED to develop numerical life cycle population models.

adjust to the year-to-year and within-year changes in water conditions. This component of the EWA program runs in an orderly way.

Public Outreach

The efforts to include the public in the full range of EWA activities from annual workshops and reviews to weekly meetings on technical issues, water negotiations, and environmental compliance is highly commendable and has no doubt contributed to the operational success and acceptance of the program. Of particular note, was the active participation of stakeholder scientists and consultants in the data analysis and planning process for the POD. The Panel appreciates their contributions and sees their unique insights and perspective as especially valuable.

Science Funding

In past reviews the panel expressed concern about the lack of funding for research on EWA issues. However, it appears this problem has, in part, been resolved. The CALFED Science Focused Proposal Solicitation Package requested proposals on "Environmental Water," "Trends and Patterns of Populations and System Response to Changing Climate" and "Habitat Availability and Response to Change." The Panel sees the CALFED Science Fellows Program as especially valuable, and notes that in 2005 and 2006 the Fellows Program provided support for graduate and post-graduate fellows in research areas directly relevant to EWA issues. As a result of these earmarks, a number of high quality proposals and researchers were funded. The Panel commends these actions and encourages a concerted effort to incorporate the results of the new research initiatives into EWA management. In particular, the POD workshops and analyses, which

were independent of the EWA, were highly valuable in providing information on delta smelt. **The Panel continues to recommend research funds be earmarked directly to EWA issues and encourages a concerted effort to incorporate the results of the new research into EWA management**.

Exchange of Ideas

The CALFED workshops and seminars related to EWA actions and issues are excellent vehicles linking research and management, and also serve as a means for disseminating information to the public. **The Panel encourages the continued use of workshops to address specific topics. For example, a seminar or workshop on the response of juvenile salmon to hydraulic conditions at bends and junctions would help to complement the new research on that issue that is becoming available.**

Program Documentation

The panel appreciates CALFED and the EWA staff for their effort in developing presentations and documentation for the November 28-30 workshop. The cross-linked, web available presentations and background material, and the summary documents by the science advisors, were of great help. The EWA staff document "Improving the EWA implementation process: Science program and EWA agencies progress in water years 2005 and 2006" is noteworthy in that it included past panel recommendations, actions taken by agencies, action goals, resource commitments, and progress in implementing the recommendations. **The panel recommends using this structure in future reviews. The panel recommends more use of web-linked documents in reviews. These could**

supplement the PowerPoint presentations with background information, such as the proposals and work plans of projects referred to in the presentations.

Reviews

We note that the EWA program is among the most reviewed and critiqued of all CALFED programs. Besides the five formal reviews by EWA Technical Review Panels, the science advisors have provided insightful and clear assessments of the strengths and weaknesses of the program (e.g., Brown et al. 2006) and internal assessment of the status of implementation of EWA (Chappell et al., 2006). The workshops provide additional review and oversight of the program, and are useful in identifying impediments to the further development of science-based management of environmental water. **This multi-tiered review structure is important and the Panel supports the continuation of EWA reviews on a bi-yearly basis. The EWA review process should serve as a template for other programs such as the VAMP.**

Improved Statistical Analyses

Statistical analysis of EWA studies has improved since the inception of the program. Noteworthy are the review of delta smelt analyses by a statistical consultant and the inclusion of a statistician on the EWA staff. Additionally, the new Delta Action 8 studies on reach survival will use the Jolly-Cormack-Seibert survival methodology, which is the state of the art for such studies. **The panel encourages expanded use of internal and external statistical consultants.**

Improved Scientific Thinking and Conceptual Models

In the first year of the EWA program (2001), the allocation of water resources was driven by the need to reduce the take of organisms at the pumps. In the second year review (2002), the Panel advocated developing life cycle models of delta smelt and salmon, and in the fourth review (2004) the Panel recommended quantifying the impact of exports through population models. In this year's review (2006), the Panel notes progress in the use of mechanistic and life cycle perspectives to characterize the impacts of water exports. The Panel notes that several biological responses are now being tracked, including take at the pumps, passage of fish at the Delta Cross Channel, and the delineation of the Delta entrainment zones. We list eight studies that demonstrate an improved scientific approach.

- In the 2004 review, the Panel recommended the Particle Tracking Model (PTM) be used in EWA decision-making and research; this occurred in 2005 and 2006. The model allows managers to address the effects of EWA actions on delta smelt prior to their entrainment at the pumps. The application of the model is a first step in the real-time management process envisioned by the Panel in past reviews. **The Panel encourages the continuation of this work and the further application of particle tracking models to understand the movement of delta smelt at junctions and the effects of the HORB on the routing of pelagic organisms and salmonids through the Delta. However, conclusions drawn from the particle tracking experiments are contingent on the assumption that delta smelt move like neutrally-buoyant particles. Moreover, it is vital that any model that is used must be properly calibrated and verified. At present, the main tool in use DSM2/ PTM, does no meet these criteria. The panel**

encourages further studies to understand the effects of life stage specific behaviors on the transport of delta smelt throughout the Delta, and the effect of exports on their distribution.

- The use of Old and Middle rivers flows as a measure of export impacts is a significant improvement over expressing impacts in terms of export itself, and is an example of the increased scientific approach to analyses.

- Past studies in the Delta Action 8 and VAMP have demonstrated the effects of exports, Delta operations, and temperature on juvenile salmon migration and survival. The Panel finds the study characterizing the distribution and behavior of salmonids in the flow field of a river bend (Burau 2006), is a logical and important follow-up to these initial studies. Better understanding of the routing of fish within and through the Delta in terms of the fish's behavioral responses to hydraulic and water quality signals is essential to efficiently target environmental water to key life stages of the species at-risk. **The Panel encourages incorporating the fish's behavioral responses to hydrologic and water quality signals into the study of effects of junctions and other hydraulic features in the Delta landscape. The Panel also encourages studies to understand the hydraulic and salinity cues that mediate the delta smelt's distributions and entrainment into the pumps.**

- Dr. Bennett's conceptual model of the impacts of early spawning delta smelt on population dynamics is commendable and provocative. Embedding his analysis of delta smelt in a life history context differentiated his talk from many of the other presentations. Without commenting on Dr. Bennett's specific analyses here, the

Panel again encourages greater use of mechanistic life history approaches, like used by Dr. Bennett, to identify the impacts of water exports on fish populations in the Delta. If factors (both natural and managed) affecting delta smelt life history were coupled to factors affecting the salmon's juvenile life histories, a better understanding of the relevance of the site-specific mortality rates would emerge that could also expose areas where additional information on the life history-habitat relationships are needed. The technical panel that reviewed the OCAP Biological Opinion also suggested that the impacts of the Central Valley Project (CVP) and State Water Project (SWP) be placed in a life cycle context (Technical Review Panel 2005). An example of the life cycle approach can be found on pages 14-17 of that report.

- In the early years of the EWA program, fish routing was characterized by the recovery of coded wire tagged (CWT) fish and by "take" at the pumps. The effect of exports was characterized by aggregate measures of the export and import ratio, averaged across somewhat arbitrary temporal intervals. The resulting correlations were weak and revealed little of the biological mechanisms by which EWA actions affected fish survival and Delta routing. As a result, past EWA Panels suggested greater effort be given to identifying movement and site-specific mortality of both salmonids and delta smelt. To this end, the salmonid monitoring workshop in 2005 addressed ways to improve the monitoring program. In particular, the ultrasonic tagging system with multiple detectors throughout the Delta and the estuary is a substantial improvement and will yield estimates of

juvenile salmon survival and travel time through the freshwater habitat and into the ocean.

- The Panel believes that it is important to quantify the effectiveness of the EWA program in terms of the number of salmonids and delta smelt saved by EWA actions. Quantitatively estimating impacts is difficult and the Panel commends the initial estimates of the direct impacts of exports put forth by some of the participants at the workshop. **The Panel encourages the development of models that estimate the indirect impacts of exports. It is essential to understand those impacts resulting in the routing of fish into regions of the Delta that are favorable or unfavorable to growth and survival of particular life history stages.**

- While several CALFED programs have applied life cycle approaches to varying degrees, other programs have yet to move beyond the exploratory stage involving linear regressions of fish impacts against exports or total river flows. **Programs such as VAMP should apply mechanistic life cycle approaches that identify factors affecting routing and survival of salmonids through the San Joaquin River and the Delta. In particular, the panel encourages a mechanistic approach to understand the effects of the HORB on Delta dynamics and the resulting survival of San Joaquin salmonids.**

- In the first EWA review, take at the pumps was the primary focus used to manage the EWA water allocations. Now a variety of measures, such as smolt passage, smelt entrainment patterns, and Old/Middle River flows, are used in the Salmon Decision Tree and the Delta Smelt Risk Assessment Matrix. The incorporation of

these ecologically-based measures is a positive development. **The Panel encourages the development of general EWA performance measures and specific performance measures that are linked to critical life stages of the salmonid and pelagic organisms of the Delta.**

Real-time Tools

The array of decision support tools used in the within-season targeting of environmental water for salmon and delta smelt is commendable. **The results of the ongoing research should be used to refine the decision support tools. Changing environmental conditions and greater demands on a potentially shrinking supply of environmental water suggests that the water programs would benefit if combined into a single coordinated operation and assessment program. The Panel believes that only a coordinated program can achieve efficient and effective trade-offs of water allocations between tributaries and the Delta and across anadromous and resident species.**

Exploratory Studies

While the Panel encourages the development of life cycle based studies, it also sees as positive the expansion of exploratory analyses that seek to identify correlations between water properties and fish. Examples at the workshop was the Marston and Mesick (2006) study of San Joaquin flow and fall Chinook survival, and the studies of delta smelt historical patterns by Herbold, Guerin et al., Swansen, and Miller (Manly 2005). **The Panel encourages completion of these studies and, where appropriate,**

submissions to a peer reviewed journals, such as the San Francisco Estuary and Watershed Science, one of the many fish ecology journals, and Endangered Species Research (Inter-Research).

Response to Questions

We took the liberty, when necessary, to revise the questions to either clarify their intent or to narrow their scope. For example, we did not address the "other environmental water programs" mentioned in the first question because the Panel was not given enough information on those programs. Because the questions overlap to some extent, our responses also overlap and similar information may appear in the responses to multiple questions.

1. ***Has there been enough EWA water (in principle) to enable actions sufficient to reduce the impacts of water management on the species of concern in the Delta and associated tributaries?***

The Panel recognizes the significant progress and effort put forth to document the impacts of EWA actions, and concludes that EWA has been successful in reducing some of the impacts of water management with respect to the take-oriented objectives originally outlined for the EWA program in the Record of Decision (ROD). There is no doubt that EWA actions have reduced "take" at the export pumps, but there still appears to be insufficient data to definitely quantify the population level consequences of these reductions in take. Impacts can be either positive or negative, and, as posed to the Panel, the intent of the question is not well defined. For example, it is not clear how much reduction in take is required to have a substantial, or even measurable, effect on the

recovery of threatened species such as the delta smelt. **This highlights the need to define performance measures for the EWA program, and its relationship to other ongoing environmental and water management programs in the Delta**.

The Panel is very concerned about disturbing trends that may compromise the EWA's future value as a management tool. For example, reductions in the amount of EWA water available, and efforts to reject or modify recommendations for EWA actions, will undoubtedly compromise the program's efficacy. Furthermore, the Panel is concerned that EWA is not fully integrated in the overall scheme of water management in the system.

Despite the lack of definitive analyses, the Panel concludes that the amount of water available to EWA is not sufficient to be effective in the larger environmental context of triggering measurable population level effects. There is not enough water to simultaneously manage habitat and water quality, route salmon through the system, and make delta smelt less vulnerable to export pumping. In this larger context, the Panel is certain that more EWA water will be needed as the EWA moves into the future, or at the very least the EWA will need to be tightly integrated with actions derived from other sources of environmental water in the system. The panel was not provided enough information to evaluate the current level of integration among all sources of environmental water, hence it was not possible to assess impacts of other environmental water programs, particularly as they relate to EWA water. This is especially true for b(2) water.

The panel also believes that alternatives to reductions in export pumping will be required to recover at-risk populations, including those that may require redesign of the "plumbing" in the estuarine watershed.

2. ***Have the EWA and the other environmental water programs effectively contributed to recovery of the species of concern in the Delta and associated tributaries?***

Since the presentations at the workshop gave no evidence that any of species of concern have "recovered," the Panel was not sure of this question's intent. Environmental water programs appear to have produced mixed, localized results; for example, positive effects in Clear Creek, but a declining salmon population in the Stanislaus. In general, the answer to this question combines the answers to questions 1, 3, 4, and 5. To contribute to recovery there would have to be enough water to reduce impacts (question 1). To determine if EWA and other environmental water contributed to recovery there would have to be sufficient information from all sources (question 3). Of course, to acquire the needed information to determine if EWA effectively contributed to recovery, monitoring would have to be adequate and if it wasn't the Panel should recommend changes (question 4 and 5).

In principle, could the EWA contribute to recovery of species of concern in the future? This is another way of asking question 2 and our responses to questions 6 and 7 are at least partial answers. To enhance the EWA's ability to contribute to recovery, the current EWA program should address the following:

- The EWA needs more flexibility in how the EWA assets are acquired and used.
- The amount of water available to EWA appears to be decreasing. This should be corrected.

- The pool of environmental water from all sources needs to be as fully integrated as legally possible.
- More storage and carry-over capabilities should be identified or developed.
- Funding for research and analysis on EWA related issues should increase.
- Thinking, planning and priority for the EWA should be in the context of a long-term commitment. While short-tem "panic" projects will surface, they should be in addition to EWA and should not distort the long-term commitment to an EWA or environmental water program.

These concerns are discussed in more detail in the responses to the other questions.

3. Are there sufficient information and data from all sources to determine the effects of EWA and other water programs to species of concern (i.e., populations of delta smelt and salmonids)?

There exists high quality data and models that allow us to assess how EWA affects the *physical* environment of the Delta (i.e., how changes in flows (and other operations) affect transport paths and physical characteristics). Moreover, for selected species of interest (i.e., delta smelt), there exist data about spatial and temporal variations in abundance, fecundity, etc., although analysis of the data is relatively recent (see Bennett 2005). It should be noted that current low population levels of delta smelt further confound attempts at monitoring their spatial and temporal distributions. The crucial missing components are information, models, and clearly stated hypotheses about the connection between physical characteristics and biological dynamics and variability. Making these connections is especially difficult given the small responses that may be inherent if the physical environment changes are to be attributed to the relatively small amount of water currently available to EWA.

To properly address this question, the Panel contends that the available data must be assessed in light of the need to test specific hypotheses about EWA effects on specific life stages and processes, for example:

- Are there sufficient data to determine the effect of EWA on pumping induced mortality? The underlying assumption here is that we can *a priori* establish the level at which this source of loss is significant to the population. In this case, there is sufficient data to make a reasonable (uncertainty yet to be defined) connection between what portion of the population is drawn towards the pumps given a measurement of how delta smelt are distributed throughout the Delta. The data and information limitations are lack of knowledge of fish behavior and the fact that the predictive step requires use of a model (PTM) that has never been fully or completely validated so that its accuracy is unknown. Unfortunately, fish salvage cannot be related accurately to entrainment into Clifton Court because the effects of predation and screen efficiency are highly uncertain.
- If it is hypothesized that habitat availability limits delta smelt abundance in some way, then the question would be: Are there sufficient data to determine effect of EWA on suitable habitat for delta smelt at different life stages? For water characteristics like salinity, light, temperature, or contaminant concentrations, the answer is yes. However, again this kind of information cannot currently be translated into population level effects largely because of a lack of synthesis rather than lack of data. The Panel is aware however that one major data gap does exist in this regard: we have no data pertaining to what spawning substrate delta smelt are using, and whether or not this substrate is limiting.
- A third possible hypothesis is that delta smelt are food limited in some way. In this case, the question would be, does EWA affect food web dynamics in a way that is relevant to delta smelt growth, survival or reproductive output, and is

measurable? In this case, while we do have the data and models that can link different hydrologic conditions and operations to primary production, we cannot connect changes in primary production with food limitation at any life stage for delta smelt.

This difficulty in connecting observable changes in Delta conditions in response to water operations like the EWA must be seen in light of the decades-long effort by the Inter-Agency Ecological Program (IEP) to address this question for the much larger quantities of water associated with overall diversions from the system. In this larger context, we know that at the broadest levels there are relationships between flow and abundance of many organisms (Jassby et al 1995), although not for delta smelt. However, the mechanistic basis of those relationships, while largely reasonable, is still based on unproven hypotheses.

In summary, the Panel (again) asserts that attempts to tease out the singular importance of the EWA as a factor affecting the populations of key fish species are unlikely to yield definitive results, given the relatively small size of the EWA and the large inherent variability of the underlying hydrologic environment inhabited by the fishes of interest. Analyses are emerging that move towards documented and well-stated hypotheses (e.g., negative (southward) flows in Old and Middle Rivers are likely to result in increased salvage of delta smelt). The Panel feels that such hypothesis-driven research and analyses is necessary for significant progress to be made. The magnitude of the benefit and the efficacy of the EWA as a tool in restoring and sustaining threatened fish populations in the Delta remain to be determined. As suggested by Wim Kimmerer's

preliminary analyses: EWA at its current size might only be expected to yield a small (on the order of a few percent) change in overall population levels.

For salmon, there appears to be sufficient information from the Delta 8 study to estimate the effect of the EWA on the migration and routing of juvenile Chinook salmon. Patterns between Vernalis flow and the HORB operations and San Joaquin salmon migratory survival and adult returns suggest that water operations may affect these fish. However, the data are limited and because correlation does not imply causation, the Panel does not believe sufficient information or documentation is available to ascribe the patterns to specific operations.

Finally, the Panel thinks it useful to draw attention to the difficulties inherent in attempts at engineering the operation of the Delta. It seems highly likely that EWA actions aimed at helping San Joaquin salmonids (e.g., VAMP-related actions), might have negative consequences for delta smelt, especially when exports are maintained and the HORB is in place. **Thus, it seems important to view any EWA actions in light of their full range of potential effects, rather than only in terms of their effects on single at-risk species.**

4. ***Is the current monitoring effort by the agencies sufficient to provide the needed information on population level effects and responses to EWA water use? and,***

5. ***If there is insufficient data and information to determine the efficacy of the EWA, what scientific approaches are needed to address the problem and allow that determination?***

The Panel commends the agencies for obvious and accelerated progress in using the monitoring data to explore the population level effects of hydrologic variability and

EWA actions. It was very clear to the Panel that much has been learned since the last EWA Panel review. There was a lengthy discussion at the workshop about whether the new findings were attributable to EWA science or to the POD crisis. Regardless, the Panel is not surprised that significant progress was made in response to new monetary and personnel resources being devoted to the collection, management, and interpretation of existing and new data. From the first technical review to the most recent, the Panel has always suggested that allocation of additional resources to monitoring would pay high dividends.

Some important issues (dilemmas) were raised during the 2006 review, and the Panel believes these new issues could have considerable influence on data needs, and therefore on the goals and designs of current and future monitoring. These issues include:

- Hydrographic changes due to climate, consumptive water uses, and water storage affecting water availability differentially in the Sacramento versus the San Joaquin drainage basins. These factors appear to restrict water management options in the San Joaquin side of the system;
- Changes in upstream water use, particularly in the San Joaquin basin, have resulted in a slow and steady change in salinity patterns in the south Delta, especially in the fall. As such, the system is being "pressed" towards decreasing habitat quality for some desirable species and species distributions could shift;
- **Both winter run Chinook salmon and delta smelt would benefit if the water exported at the pumps was derived mostly or entirely from the San Joaquin River, thus resulting in positive flows in the Old and Middle Rivers.**

However, the use of San Joaquin water could have negative impacts on the salmon runs in the San Joaquin basin.

- **In its current size and application, the EWA is not sufficient to address the water-routing issues described above. It may be necessary to re-engineer the system to maximize the potential for export of San Joaquin River water before it reaches the Delta. This may not be possible if San Joaquin flows are insufficient to satisfy the water volume needs at the pumps under the current management regime**. The Panel also believes that future EWA actions could become more important, especially for delta smelt, if San Joaquin River flows continue to decline.

These issues put pressures on the monitoring program because they can affect the utility of presently collected data. Dealing with these issues will require either changes to the existing monitoring program, or additions to the existing monitoring program, in order to generate the data needed to quantitatively accommodate or evaluate these issues.

To maximize the effectiveness of EWA water, it may be necessary to identify tradeoffs associated with actions that benefit one species at the expense of other species, which may ultimately lead to prioritization of actions based upon the relative risk of jeopardy. These tradeoffs will need to be quantified and dealing with these tradeoffs will require "new thinking" about monitoring and data collection. Can sufficient data be collected to allow for quantification of the population-related effects of management actions on multiple species, and can the quantification be precise and accurate enough to allow evaluation of tradeoffs?

The Panel was buoyed by some of the analyses that used the monitoring data presented at the review workshop, such as the "big mama" hypothesis addressed by Dr. Bennett and attempts to combine existing data in new ways (e.g., results from particle tracking models and salvage data to estimate entrainment rates). The Panel believes strongly that "new thinking" will continue to result in improved understanding of cause and effect in the system. **The Panel also believes that knowledge of cause and effect may be enhanced by increased flexibility in methods and locations of data collection that include new studies and monitoring specifically designed to address process-level questions.** However, this does not mean that the Panel is recommending abandonment of existing monitoring sites that are valuable because they have been sampled over many years. Historical perspective is important. **Rather, we are recommending new studies, both descriptive and experimental, that are informed by the new information gained as a consequence of the POD funding. If no new EWA-specific sources of funding can be obtained for this purpose, it may be efficacious to dedicate a small portion of the EWA funds now used for buying water to new studies, despite the aforementioned problem of decreasing trends in the amount of EWA water. In the long term, this maybe a good trade off for improving the efficiency of EWA water use.**

With that said, **the Panel also recognizes the need to improve statistical rigor and discipline during data analysis. Further attempts at data mining that is not hypothesis driven is discouraged.** The group should avoid development and interpretation of numerous regression analyses based upon the same data, especially ratios of data, without considerations of statistical assumptions and possible

multicolinearity of independent variables. Given the data at hand, analysts should also consider power analysis to determine the size of effects that can be realistically identified.

In order to prevent the pitfalls associated with contradictory results from similar data and analyses, the Panel feels strongly that it is important now for the agency and stakeholder groups to close the loop and begin a new phase of cooperation and collaboration among analysts. This cooperation is needed to rectify disparate interpretations about cause and effect based upon results employing the same monitoring and special studies data sets. Consensus will be extremely important when deciding how EWA should proceed beyond 2008.

There are numerous other ways to improve the quality of data collected relative to its quantity, and the recommendations fall into the following three general areas:

- **Focus on needs identified during development of population models to elucidate cause and effect, and to inform the models;**
- **Narrow the questions attempting to be addressed and express them as well-documented and clearly stated hypotheses. Focus on the factors affecting the distribution and abundance of all life stages of delta smelt in space and time, including delineation of spawning habitat. Many of these questions can be addressed by amending the existing sampling programs. Keep in mind, however, that sampling stations used for multiple purposes can compromise their value; and,**

- **Determine to what extent the lack of understanding and quantification of gear efficiencies can mask relationships, inflate uncertainty, and preclude defensible estimates of population size based upon monitoring results.**

Other focus areas for new research include but are not limited to: behavior of fish in responses to flow; improvements in monitoring in real time; genetics studies for unequivocal identification of members of specific salmon runs; estimation of mortality rates of delta smelt and salmon smolts in the Delta, in the Clifton Court Forebay, and in the pumping facilities; and estimates of entrainment of all at-risk species.

6. What scientific components should be considered while implementing EWA in 2007?

We interpreted question six as a direct reference to the Action Matrix. The Panel's review of the Action Matrix was sent to the Lead Scientist in a letter dated January 2, 2007 (See Appendix 2).

7. What scientific components and considerations should be included in a future and/or long-term environmental water program? Are there components that could be included to improve our understanding of water management on ecosystem function and species' population dynamics?

The Panel wants to emphasize that it agrees with the presumption in the wording of the question that there should be an overall environmental water program. **The Panel endorses the idea of viewing environmental water from all sources together as a common pool. We also recognize that there are legal issues and binding agreements**

that dictate that some of the environmental water must be used in certain ways. We encourage efforts to waive or remove, as much as possible, institutional barriers that hinder the pooling of environmental water from all sources.

Another important component to a future environmental water program, and critical to a common water pool approach, is that all programs using the water should be reviewed. These include programs like VAMP and the use of b(2) water. One should not simply collate the current sources of environmental water, but rather a fish life-cycle approach should be used to determine the best mix of actions from an environmental water program. We emphasize the *integration* of environmental water and actions in an environmental water program; simply putting the present separate sources of environmental water together in a single list is not integration. There must be flexibility in how the water is used, and there must be the ability to store and carry-over water between years.

A related consideration is that somehow enough water must be dedicated for environmental use to make an ecological impact. This begins to be achievable if the environmental water from multiple sources is pooled. In addition, more water, without any constraints associated with its use, should be added to the pool. In recent years, there has been a disconnect between the size of the EWA (about 300,000 acre-feet of water) and the expectation that EWA should contribute to species recovery. **In a future environmental water program, either aiding recovery is a goal and sufficient water is allocated, or the goal should be revised so expectations and resources are compatible.**

A fish life cycle approach should be the cornerstone for a future environmental water program. We encourage the steps that have been taken in EWA towards the broader life cycle view of the key species such as delta smelt. The idea of using water to help the species at risk beyond reducing take (e.g., to improve habitat) is gaining momentum and the Panel encourages continued thinking in this direction in a future environmental water program.

A future environmental water program should include an analysis component with dedicated resources (either staff or contracting money). Analysis here includes quantitative methods such as statistical analysis of data, population modeling of key species, and gaming. Progress in statistical analysis and population modeling was evident at the November 28-30 workshop. However, some of these advances were in response to POD pressure, rather than directly due to EWA issues. The progress in data analysis and modeling needs to continue and accelerate, and must play a major role in a future environmental water program. Statistical analyses need to move beyond the linear regressions of index variables towards process-based analyses. **Dedicated staff is the most efficient way to achieve the level of quantitative analyses needed in a future environmental water program**. Difficulties with contracting were a hindrance in the past but this seems to have greatly improved. The CALFED Science Program has played a role to date and should play an increasing role in analysis support in a future environmental water program.

Gaming proved very valuable for initially sizing the EWA. It has been about ten years since that initial gaming exercise. **It is time to revisit gaming to help size and "optimize" the mix of actions under different conditions (e.g., wet versus dry years)**

in a future environmental water program. A new gaming exercise can now include biological life-cycle models that were not available ten years ago.

Additional critical aspects for a future environmental water program are achieving greater water supply reliability, better mechanisms for purchasing environmental water, and cooperation among agencies and stakeholders. Judging by the lack of conflict in recent years, these seem to have been successful in the EWA to date and should be continued. However, prior success should not lead to complacency about these important issues in the future.

Finally, a very important component that is missing from the present EWA is research and monitoring. Monetary and staff resources should be set aside to support research on specific questions that will arise with an integrated environmental water program. The analysis component discussed above would be a part of this research and monitoring component. A future environmental water program will clearly benefit if CALFED Science funds projects and other supporting activities (e.g., population models, workshops, Science Fellows). But one cannot guarantee that all questions that will arise in an environmental water program will be addressed in a timely manner *via* proposal solicitations. Also, while the recent surge of effort associated with the POD has benefited the EWA, this cannot be assumed to continue into the future. **Therefore a future environmental water program should have the resources to support research and analysis of its specific questions and issues. Examples include, but are not limited to, population estimation from monitoring data, what to do in wet years (given recent wet years did not benefit fish as expected), statistical analysis of data, trade-offs between upstream and downstream actions and among multiple species, and the**

likely effects of climate change. The Science Program can be used to help select the contractors and coordinate the funding details. Also, there should be a monitoring component to a future environmental water program designed to specifically track the effects of environmental water program actions. This monitoring would best be done as additions and modifications to the IEP and other sampling that has been done to date to ensure continuity over time, but with the specific goal of tracking environmental water program actions through the life cycles of at-risk species.

Literature Cited

Brown L., W. Kimmerer and R. Brown. 2006. A novel way of managing water to protect fish: a review of California's Environmental Water Account. Online material for 2006 EWA Review, http://science.calwater.ca.gov/pdf/ewa/EWA_paper_revision_112706.pdf.

Burau, J. R. 2006. Understanding juvenile salmon movement and survival in the north Delta. CALFED EWA Conference 2006, Sacramento, CA.

Chappell E., V. Poage, A. Low, B. Oppenheim, R. Brown and J. Machula. 2006. Improving the EWA Implementation Process: Science Program and EWA Agencies' Progress in Water Years 2005 and 2006. Online material for 2006 EWA Review, http://science.calwater.ca.gov/pdf/ewa/EWA_updated_implementation_process_05-06_112106.pdf.

Jassby, A.D., W. J. Kimmerer, S. G. Monismith, C. Armor, J. E. Cloern, T. M. Powell, J. R. Schubel, and T. J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. *Ecol. Appl.* 5: 272–289.

Marston, D., and C. Mesick. 2006. Role of spring flow in determining San Joaquin River tributary salmon production. CALFED EWA Conference 2006, Sacramento, CA.

Technical Review Panel. 2005. Review of the biological opinion of the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan. California-Bay Delta Authority. Sacramento, CA.

Appendix 1

EWA Review Panel Members:

NAME	AREA OF EXPERTISE
Jim Anderson	Salmonid biology
Jim Cowan	Fish biology
Jim Lichatowich	Salmonid biology
Ron Kneib	Landscape ecology, estuarine fisheries
Steve Monismith	Hydrodynamics
Kenny Rose	Fish biology, population modeling
Andy Solow	Biostatistics
Paul Smith	Fish biology
Buzz Thompson	Natural resource law, Water law

Appendix 2

January 2, 2007

Dr. Michael Healey
Lead Scientist, California Bay-Delta Authority
CALFED-CBDA
650 Capitol Mall, 5th Floor
Sacramento, CA 95814

RE: Review of Resource Agencies Action Matrix for 2007

Dear Dr. Healey:

The EWA Technical Panel attended the annual program review on November 28-30, 2006. As in past years, the panel was charged with the preparation of a report that provides, "… a comprehensive evaluation of the EWA to determine the biological benefits of EWA and other environmental water in recovery of at-risk native species and provide recommendations on water allocation priorities…." We were given seven questions to consider when preparing our report. This year the Panel was requested to address an additional task. We were asked to prepare a separate evaluation of the Resource Agencies Action Matrix presented at the program review by Jim White and Kevin Fleming. We were given five questions to consider when preparing that report. The purpose of this letter is to present our findings on the Action Matrix.

The matrix lists six potential experiments, and for each, there are nine cells that give information such as the timing of the action, triggering events, scientific uncertainty, and response variables. The information in each cell is reduced to bullet form, which gives an indication of the thinking that went into the design of a proposed action, but not a complete description of it. On December 11, 2006, the Panel received supplemental information on the matrix, which did provide new insight into the rationale for the proposed actions, but was still considered insufficient for a detailed review by the panel.

We generally agree in concept with the approach described in the matrix and supplemental information such as describing the actions, their rationale, response variables, etc. This approach gives the management actions an improved technical basis. The panel encourages the managers to continue with this approach and, in the future, provide more explanation and scientifically defensible justification for the actions and to quantify as many of the components of the matrix as possible. Our answers to the five questions suggest the kind of additional information that would be useful.

We disagree with the use of the term "experiment" to describe the management actions in the matrix. Labeling the management actions as experiments creates the temptation to over interpret the results and it may suggest that the results have greater validity than is warranted. The lack of experimental controls (to compare with the treatment) and little or no replication undermines the power and rigor of any conclusions that might be drawn from changes in delta smelt abundance. An experimental approach needs greater attention to the analyses of existing information, hypothesis development, experimental design (including controls), sample sizes and duration (number of years) of the experiment. The latter two should be derived from a power analysis. In our opinion, the proposed actions for 2007 describe new management actions not scientific experiments. Consequently our answers to the five questions must be interpreted with that constraint in mind. We repeat each question followed by our answer:

1. Evaluate the technical assumptions and conceptual models underlying proposed matrix actions including action triggers, signal-to-noise ratios for response variables, measurement of response variables, and additional proposed field sampling.

We divided our answer to this question into comments on the conceptual model and comments on the stated hypotheses.

Comments on the conceptual model

A conceptual model is not specifically stated so we cannot give a definitive answer to this question. The overall working hypothesis in the Draft Supplemental Information implies a conceptual model based on the delta smelt's life cycle in which adult delta smelt migrate upstream in the winter, larvae hatch in the spring and juveniles grow while drifting downstream in the summer and autumn. Growth is determined by food availability, which is assumed to be increased by the flux of plankton from upriver and decreased by competition from the invasive clam *Corbula amurensis*. All delta smelt life stages can be entrained in the pumps. The conceptual model assumes hydrodynamics and salinity affect the spatial-temporal pattern of smelt so that alteration of Delta flows as described in the Action Matrix are assumed to affect survival and reproduction success. However, whether the net impacts of proposed actions on any life stage are significant or whether the total impact of proposed actions on the population will be biologically meaningful or detectable is largely unknown. The Action Matrix also proposed actions to increase plankton influx to the Delta. As noted in the background information (*Resource Agency Pelagic Organism Action Matrix Related to Water Operations*, November 22, 2006) the general conceptual model and hypotheses were developed after the 2006 CalFed Science Conference and reflect recent studies. However, while the inferred conceptual model apparently underlies the proposed actions for 2007, it is insufficiently detailed or developed to be used in analysis of the data or for planning experiments in the future.

The Panel recommends developing a conceptual model of the delta smelt's life history that integrates potential effects of changes in hydrologic flow conditions, water quality, fish behavior and physiology on spatial-temporal scales relevant to the life stages

of delta smelt and other pelagic organisms. The Panel suggests that the conceptual model consider delta smelt and other pelagic organisms in a broader context than simply responses to operations proposed in the Action Matrix. Considering the pelagic organisms' life history strategies and how Delta development and water operations affect those strategies would provide an ecologically based approach to the eventual design of experiments. The current conceptual model only qualitatively addresses the mismatch between the evolved behavioral and physiological patterns and the existing hydraulic and water quality conditions in the Delta. The Panel encourages the continued research and development of an explicit, spatial-temporal life-cycle model as a foundation for designing Delta-wide experiments. A serious information gap that presents a barrier to the formulation of practical hypotheses is that the in-delta spawning migration behavior of delta smelt (timing, selection of spawning sites, etc.) is not well described. Also, there is no field measure of egg production per spawner and no consideration for the effect of food availability on reproductive output in space and time. The latter, in particular, could be important in the case of repeat spawners. We suggest that a model, which reasonably characterizes the spatial temporal life history patterns, will be needed to identify action triggers, and sampling protocols for future experiments. In brief, Delta experiments can most effectively be designed and implemented, if first developed in silico.

Comments on the hypotheses

A focus on the testing of specific hypotheses is a good approach, but more planning should go into the process before actions are taken because so much uncertainty is involved. The hypotheses are in essence predictions of the effects of actions, but they do not characterize the underling mechanisms. There may be ways of objectively evaluating these as being true or false at the end of a defined time period. However, the longer the time period between an action and a predicted response, the lower the likelihood of being able to connect the two as cause and effect. The panel questions whether it is possible to evaluate the responses to actions outlined in the 2007 Action Matrix

For example, consider the May-December hypothesis: "*Higher Delta outflow in summer and fall will expand suitable habitat available to delta smelt, shifting their distribution downstream and so reducing winter entrainment.*" The primary responses are the location of X_2 and the distribution of delta smelt in the FMWT survey. A number of unstated processes link the action to the response variables and many of these are not understood or cannot be controlled. For example, the effect of increasing Delta outflow is contingent on the water year conditions, which will alter the entire hydraulic environment and distribution of smelt prior to, during and after the May-December action. The assumption underlying this prediction is that flow affects smelt distributions. The panel suggests a more relevant question would be to study or explore how flow and water quality properties affect smelt behavior that in turn determines smelt migration. The current Action Matrix and the associated monitoring are not sufficient to address this. However, an understanding of fish response is needed to understand how the population will respond to Delta-scale manipulations.

2. Evaluate response time for detecting effects of proposed actions identified in the matrix.

The Panel believes that a meaningful evaluation of the time required to detect the effect of a proposed action is vitally needed, but was not included in the Action Matrix. Whether the time required to detect responses can be quantified should be determined by an analysis of the existing data. Some understanding of the individual responses of fish to the action and the fish's response to the sampling gear will be required. Also needed is a power analysis to determine the magnitude of response necessary to confidently detect a change in abundance, size distributions, etc. using the proposed sampling methods.

3. Provide input on response variables and the relationship between multiple year responses to single- or multiple-year actions.

A consistent problem in ecology is separating the effects of natural variation from the response to a planned action. Identifying the effects of actions whose responses are measured in later life stages or subsequent generations is especially difficult. Most of the response variables in the Action Matrix are affected by demographic processes as well as seasonal environmental variability. Consequently, detecting interannual responses will be extremely difficult given the level of effort identified. To further complicate the issue the plan has numerous actions, so attribution of a cause is speculative. In essence, it is highly unlikely that the specific effects of single or multiple-year actions can be identified.

4. Provide independent perspective regarding characterization of scientific uncertainty in proposed actions and responses.

The panel encourages the use of uncertainty assessments in designing experimental procedures. However, the Panel has insufficient information to apportion uncertainty in the 2007 actions. Given the limitations of the existing knowledge base, the large scope for variability in the system, and the generally high level of scientific uncertainty expressed in the best professional judgment of agency personnel, it would be unrealistic to expect results that had much predictive value.

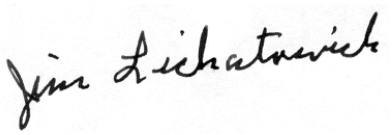
5. Evaluate potential contribution of proposed actions and subsequent measurements to improving estuary-wide knowledge base regarding declining pelagic species.

It appears the responses to the proposed actions will be observed with the existing Delta monitoring programs. Because it is still unresolved as to how past variation in the Delta water quality and hydraulics has affected the delta smelt distribution and population, it seems unlikely that modest changes on top of the natural conditions in 2007 will be informative.

We interpreted question six in our charge as a direct reference to the Action Matrix, so this letter will serve as our review of the Action Matrix as well as the answer to question six in our overall charge.

We appreciate the opportunity to comment on the Action Matrix.

Sincerely,



Jim Lichatowich
For the entire panel

Panel Members: Jim Anderson, Jim Cowan, Ron Kneib, Jim Lichatowich, Steve Monismith, Kenny Rose, Paul Smith, Andy Solow, and Buzz Thompson.

EXHIBIT 5

CENTRAL VALLEY OPERATIONS OFFICE

DELTA SMELT AND SPLITTAIL

June 2004

Note: Bold numbers are not verified by DFG.

DATE	Delta Smelt				Splittail				Pumping					
									Daily Total In CFS			Daily Total In Acre Feet		
	Daily Total		Combined		Daily Total		Combined							
	SWP	CVP	Daily Total	14-Day Average	SWP	CVP	Daily Total	14-Day Average	Banks	Tracy	Combined	Banks	Tracy	Combined
1-Jun-04	1705	24	1729	394	33	516	549	465	1926	4337	6263	3820	8602	12422
2-Jun-04	1077	36	1113	445	33	492	525	487	1881	4266	6146	3730	8461	12191
3-Jun-04	75	12	87	411	6	228	234	477	637	2223	2860	1263	4409	5672
4-Jun-04	0	24	24	399	0	180	180	480	169	1417	1587	336	2811	3147
5-Jun-04	6	24	30	393	0	168	168	472	110	1848	1958	218	3666	3884
6-Jun-04	234	36	270	400	0	156	156	466	869	1860	2729	1723	3690	5413
7-Jun-04	180	24	204	403	0	504	504	482	951	2286	3237	1886	4534	6420
8-Jun-04	333	24	357	418	21	396	417	485	954	2684	3638	1892	5323	7215
9-Jun-04	339	72	411	434	6	396	402	492	2006	3350	5356	3978	6645	10623
10-Jun-04	195	108	303	443	12	228	240	487	2432	3642	6074	4823	7224	12047
11-Jun-04	111	48	159	406	15	216	231	476	2947	3656	6603	5845	7252	13097
12-Jun-04	144	24	168	392	6	168	174	439	2758	3641	6399	5470	7222	12692
13-Jun-04	129	48	177	389	27	264	291	375	2775	3633	6408	5505	7206	12711
14-Jun-04	207	12	219	375	53	120	173	303	2837	3272	6109	5628	6490	12118
15-Jun-04	189	0	189	265	15	96	111	272	2678	3446	6125	5312	6836	12148
16-Jun-04	111	12	123	194	54	36	90	241	2855	3669	6524	5663	7278	12941
17-Jun-04	99	12	111	196	6	60	66	229	1537	3373	4910	3049	6690	9739
18-Jun-04	111	12	123	203	21	48	69	221	1101	4206	5307	2184	8342	10526
19-Jun-04	36	12	48	204	0	48	48	212	773	4374	5147	1533	8676	10209
20-Jun-04	66	12	78	191	0	48	48	205	1544	4360	5904	3063	8648	11711
21-Jun-04	69	12	81	182	3	12	15	170	1530	4354	5885	3035	8637	11672
22-Jun-04	95	0	95	163	0	12	12	141	1727	4341	6069	3426	8611	12037
23-Jun-04	42	0	42	137	0	60	60	116	1717	4333	6050	3406	8595	12001
24-Jun-04	75	0	75	121	0	0	0	99	1319	4333	5652	2616	8595	11211
25-Jun-04	48	0	48	113	18	0	18	84	1574	4302	5877	3123	8534	11657
26-Jun-04	24	12	36	103	0	36	36	74	1275	4285	5560	2529	8499	11028
27-Jun-04	0	12	12	91	0	0	0	53	1565	4298	5863	3104	8526	11630
28-Jun-04	54	0	54	80	0	36	36	44	1396	4325	5721	2769	8578	11347
29-Jun-04	14	12	26	68	6	0	6	36	947	4324	5271	1879	8577	10456
30-Jun-04	0	0	0	59	0	36	36	32	1125	4338	5463	2231	8605	10836
Total	5768	624	6392	XXXX	335	4560	4895	XXXX	47915	108778	156693	95039	215762	310801

Delta Smelt Incidental Take Levels

Yellow Light Level = 400 (14 day Average)

Red Light Level = 47,245 (June-Below Normal)

EXHIBIT 6

Delta Smelt Working Group Meeting Notes

June 25, 2007

Participating: Julio Adib-Samii (CDFG), Gonzalo Castillo (USFWS), Mike Chotkowski (USBR), Kevin Fleming (CDFG), Fred Feyrer (CDWR), Erin Gleason (CDFG), Lenny Grimaldo (CDWR), Bruce Herbold (USEPA), Tracy Hinojosa (CDWR), Ann Lubas-Williams (USBR), Jim White (CDFG) and Victoria Poage (USFWS, convener and scribe)

For Discussion:
1. Update on current conditions and survey data
2. Discrepancy in salvage between CVP and SWP

Recommendation for WOMT: The Delta Smelt Working Group was not able to arrive at a consensus recommendation. Members of the Working Group will clarify their positions in writing for WOMT as soon as possible.

1. Fish and Game staff are in the process of sorting samples from survey 8 of the 20-mm Survey. Thus far they have collected no delta smelt at south or central Delta stations, and the total sample number is 53 (51 at station 706 near Decker Island and one each at stations 513 and 716). It seems likely that crews sampled a small school. This brings the grand total for the 2007 survey season to 90, still very low compared to other years. From 1995 through 2006, survey 8 collected an average of 134.9 delta smelt (range=42-218) and for surveys 1 through 8 collected an average of 1309.4 (range=587-3407).

Survey 2 of the summer Tow-Net Survey began today; no data was available at the time of the call. Delta water temperatures are slowly warming; Clifton Court Forebay was at 24.2^{0}C yesterday (June 24) and the three-station Delta average was 23.3^{0}C. It is worth noting that DFG netted outside the CCF radial gates in 1994 at 25.6^{0}C and collected delta smelt.

2. Recent salvage of delta smelt is summarized in the following table:

Date	Exp. SWP Salvage	SWP Salvage Density	Exp. CVP Salvage	CVP Salvage Density	Combined Salvage	Cumulative Salvage	Daily Net OMR Flow
6/14/07	9	50.5618	0	0	9	620	-2623
6/15/07	18	94.24084	0	0	18	638	-2634
6/16/07	9	46.875	0	0	9	647	-2420
6/17/07	168	171.2538	12	2.24341	180	827	-2597
6/18/07	90	113.4931	0	0	90	917	-3509
6/19/07	90	54.02161	0	0	90	1007	-3510
6/20/07	9	6.329114	0	0	9	1016	-2138
6/21/07	30	16.23377	0	0	30	1046	-1895
6/22/07	57	30.77754	0	0	57	1103	-3360
6/23/07	15	8.004269	0	0	15	1118	
6/24/07	24	20.61856	0	0	24	1142	

There is a notable disparity between salvage at the State and Federal facilities, both in terms of numbers and in terms of density. The State is not opening the radial gates completely, taking water into CCF at a much lower instantaneous rate to minimize the impacts of radial gate operations, while the CVP has been at capacity since June 19. Recent flows in Old and Middle Rivers have ranged approximately from -2000 cfs to -3500 cfs. According to particle tracking modeling run earlier, the Working Group would expect to see little or no salvage, given smelt distributions suggested by survey sampling results, as the Projects would not be taking much water from the Sacramento River.

It is unlikely that the SWP is drawing water that is not accessible to the CVP; the three South Delta agricultural barriers are all operating tidally, a condition of which many on the Working Group were unaware, and requested that in the future, DWR keep them better informed of changes in barrier operations. There has been an overall declining trend in delta smelt densities at the SWP, which may be an indicator that recent salvage has consisted largely of fish resident in Clifton Court Forebay. Surface temperatures reached 26^0C in CCF, but the irregular bathymetry of the Forebay may create thermal refugia sufficient for juvenile delta smelt to survive, although probably not in large numbers. There are operations-related actions that could be taken by DWR to support inferences on the origin of the salvaged delta smelt, including:

1. drawing a large volume of water into CCF on a high tide, allowing it to mix, and then releasing it back through the radial gates on a low tide, creating a flushing action; if delta smelt were released into Delta channels, then they should be salvaged at the CVP
2. continue export pumping but with the radial gates closed, drawing CCF down to dead pool to remove as many smelt as possible, then resume normal radial gate operations and monitor salvage numbers and densities

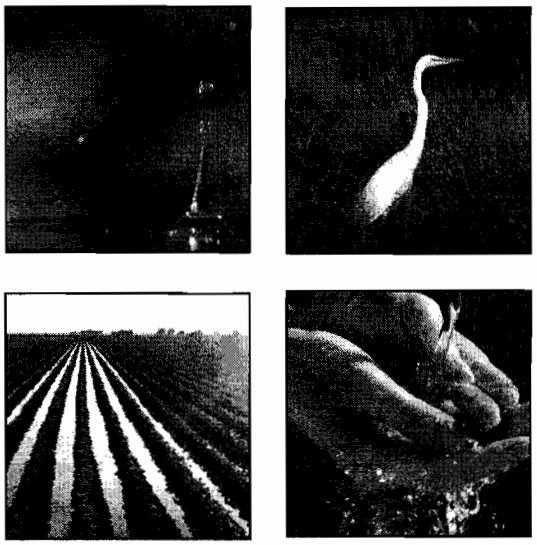
Both of these potential activities may be problematic; they would very likely produce ambiguous results, and they may constitute violations of the SWP's diversion permit, and therefore not be workable. Both ideas were, however, submitted to DWR for further consideration.

During the course of discussion, the Working Group attempted to reach a consensus as to the meaning of the observed salvage, whether a recommendation was warranted, and what the recommendation, if any, might be. The Working Group was not able to achieve a consensus on any of these three points. Some believed that the salvage observed at the CVP was an indicator that delta smelt were not present in Delta channels, and that the present level of exports did not constitute a concern. Others believed that the uncertainty created by the disparity in salvage between the two Projects was sufficient cause for continued high concern. As consensus could not be reached, the various viewpoints must be written up and submitted individually as addenda to these notes.

Next meeting: July 2, 2007 at 3:00 pm, via conference call

Submitted,
VLP

EXHIBIT 7



Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

December 13, 2006

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

Division of Water Rights
December 2006

COV0125

Table 3
WATER QUALITY OBJECTIVES FOR FISH AND WILDLIFE BENEFICIAL USES

COMPLIANCE LOCATIONS	INTERAGENCY STATION NUMBER (RKI [1])	PARAMETER	DESCRIPTION (UNIT) [2]	WATER YEAR TYPE [3]	TIME PERIOD	VALUE
DISSOLVED OXYGEN						
San Joaquin River between Turner Cut & Stockton	*(RSAN050-RSAN061)*	*Dissolved Oxygen (DO)*	*Minimum DO (mg/L)*	*All*	*Sep-Nov*	*6.0*
SALMON PROTECTION						
			narrative	*Water quality conditions shall be maintained, together with other measures in the watershed, sufficient to achieve a doubling of natural production of chinook salmon from the average production of 1967-1991, consistent with the provisions of State and federal law.*		
SAN JOAQUIN RIVER SALINITY						
San Joaquin River at and between Jersey Point and Prisoners Point [4]	*D-15 (RSAN018)* ***-and-*** *D-29 (RSAN038)*	*Electrical Conductivity (EC)*	*Maximum 14-day running average of mean daily EC(mmhos/cm)*	*W,AN,BN, D*	*Apr-May*	*0.44 [5]*
EASTERN SUISUN MARSH SALINITY[6]						
Sacramento River at Collinsville ***-and-*** *Montezuma Slough at National Steel* ***-and-*** *Montezuma Slough near Beldon Landing*	*C-2 (RSAC081)* *S-64 (SLMZU25)* *S-49 (SLMZU11)*	*Electrical Conductivity (EC)*	*Maximum monthly average of both daily high tide EC values (mmhos/cm), or demonstrate that equivalent or better protection will be provided at the location*	*All*	*Oct* *Nov-Dec* *Jan* *Feb-Mar* *Apr-May*	*19.0* *15.5* *12.5* *8.0* *11.0*
WESTERN SUISUN MARSH SALINITY[6]						
Chadbourne Slough at Sunrise Duck Club ***-and-*** *Suisun Slough, 300 feet south of Volanti Slough* ***-and-*** *Cordelia Slough at Ibis Club* ***-and-*** *Goodyear Slough at Morrow Island Clubhouse* ***-and-*** *Water supply intakes for waterfowl management areas on Van Sickle and Chipps islands*	*S-21 (SLCBN1)* *S-42 (SLSUS12)* *S-97 (SLCRD06)* *S-35 (SLGYR03)* *No locations specified*	*Electrical Conductivity (EC)*	*Maximum monthly average of both daily high tide EC values (mmhos/cm), or demonstrate that equivalent or better protection will be provided at the location*	*All but deficiency period* *Deficiency period [7]*	*Oct* *Nov* *Dec* *Jan* *Feb-Mar* *Apr-May* *Oct* *Nov* *Dec-Mar* *Apr* *May*	*19.0* *16.5* *15.5* *12.5* *8.0* *11.0* *19.0* *16.5* *15.6* *14.0* *12.5*
BRACKISH TIDAL MARSHES OF SUISUN BAY						
			narrative	*Water quality conditions sufficient to support a natural gradient in species composition and wildlife habitat characteristic of a brackish marsh throughout all elevations of the tidal marshes bordering Suisun Bay shall be maintained. Water quality conditions shall be maintained so that none of the following occurs: (a) loss of diversity; (b) conversion of brackish marsh to salt marsh; (c) for animals, decreased population abundance of those species vulnerable to increased mortality and loss of habitat from increased water salinity; or (d) for plants, significant reduction in stature or percent cover from increased water or soil salinity or other water quality parameters.*		

Table 3 (continued)
WATER QUALITY OBJECTIVES FOR FISH AND WILDLIFE BENEFICIAL USES

COMPLIANCE LOCATIONS	INTERAGENCY STATION NUMBER (RKI [1])	PARAMETER	DESCRIPTION (UNIT) [2]	WATER YEAR TYPE [3]	TIME PERIOD	VALUE
DELTA OUTFLOW						
		Net Delta Outflow Index (NDOI) [8]	*Minimum monthly average [9] NDOI(cfs)*	*All*	*Jan*	*4,500 [10]*
				All	*Feb-Jun*	*[11]*
				W,AN	*Jul*	*8,000*
				BN		*6,500*
				D		*5,000*
				C		*4,000*
				W,AN,BN	*Aug*	*4,000*
				D		*3,500*
				C		*3,000*
				All	*Sep*	*3,000*
				W,AN,BN,D	*Oct*	*4,000*
				C		*3,000*
				W,AN,BN,D	*Nov-Dec*	*4,500*
				C		*3,500*
RIVER FLOWS						
Sacramento River at Rio Vista	*D-24 (RSAC101)*	*Flow rate*	*Minimum monthly average [12] flow rate (cfs)*	*All*	*Sep*	*3,000*
				W,AN,BN,D	*Oct*	*4,000*
				C		*3,000*
				W,AN,BN,D	*Nov-Dec*	*4,500*
				C		*3,500*
San Joaquin River at Airport Way Bridge, Vernalis	*C-10 (RSAN112)*	*Flow rate*	*Minimum monthly average [13] flow rate (cfs) [14]*	*W,AN*	*Feb-Apr 14 and May 16-Jun*	*2,130 or 3,420 1,420 or 2,280 710 or 1,140*
				BN,D		
				C		
				W	*Apr 15-May 15 [15]*	*7,330 or 8,620*
				AN		*5,730 or 7,020*
				BN		*4,620 or 5,480*
				D		*4,020 or 4,880*
				C		*3,110 or 3,540*
				All	*Oct*	*1,000 [16]*
EXPORT LIMITS						
		Combined export rate [17]	*Maximum 3-day running average (cfs)*	*All*	*Apr 15-May 15 [18]*	*[19]*
				All	*Feb-Jun*	*35% Delta inflow [22]*
			Maximum percent of Delta inflow diverted [20] [21]	*All*	*Jul-Jan*	*65% Delta inflow*
DELTA CROSS CHANNEL GATES CLOSURE						
Delta Cross Channel at Walnut Grove	—	*Closure of gates*	*Closed gates*	*All*	*Nov-Jan*	*[23]*
					Feb-May 20	*----*
					May 21-Jun 15	*[24]*

Table 3 Footnotes:

[1] River Kilometer Index station number.

[2] Determination of compliance with an objective expressed as a running average begins on the last day of the averaging period. The averaging period commences with the first day of the time period of the applicable objective. If the objective is not met on the last day of the averaging period, all days in the averaging period are considered out of compliance.

[3] The Sacramento Valley 40-30-30 Water Year Hydrologic Classification Index (see Figure 2) applies unless otherwise specified.

[4] Compliance will be determined at Jersey Point (station D15) and Prisoners Point (station D29).

[5] This standard does not apply in May when the best available May estimate of the Sacramento River Index for the water year is less than 8.1 MAF at the 90% exceedance level. [Note: The Sacramento River Index refers to the sum of the unimpaired runoff in the water year as published in the California Department of Water Resources' (DWR) Bulletin 120 for

the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total unimpaired inflow to Oroville Reservoir; Yuba River at Smartville; and American River, total unimpaired inflow to Folsom Reservoir.]

[6] An exceedance of any of these objectives at a time when it is established through certification by the entity operating the Suisun Marsh Salinity Control Gates that the Gates are being operated to the maximum extent shall not be considered a violation of the objective.

[7] A deficiency period is: (1) the second consecutive dry water year following a critical year; (2) a dry water year following a year in which the Sacramento River Index (described in footnote 5) was less than 11.35; or (3) a critical water year following a dry or critical water year. The determination of a deficiency period is made using the prior year's final Water Year Type determination and a forecast of the current year's Water Year Type; and remains in effect until a subsequent water year is other than a Dry or Critical water year as announced on May 31 by DWR and U.S. Bureau of Reclamation (USBR) as the final water year determination.

[8] Net Delta Outflow Index (NDOI) is defined in Figure 4.

[9] For the May-January objectives, if the value is less than or equal to 5,000 cfs, the 7-day running average shall not be less than 1,000 cfs below the value; if the value is greater than 5,000 cfs, the 7-day running average shall not be less than 80% of the value.

[10] The objective is increased to 6,000 cfs if the best available estimate of the Eight River Index for December is greater than 800 TAF. [Note: The Eight River Index refers to the sum of the unimpaired runoff as published in the DWR Bulletin 120 for the following locations: Sacramento River flow at Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River flow at Smartville; American River, total inflow to Folsom Reservoir; Stanislaus River, total inflow to New Melones Reservoir; Tuolumne River, total inflow to Don Pedro Reservoir; Merced River, total inflow to Exchequer Reservoir; and San Joaquin River, total inflow to Millerton Lake.]

[11] The minimum daily Delta outflow shall be 7,100 cfs for this period, calculated as a 3-day running average. This requirement is also met if either the daily average or 14-day running average EC at the confluence of the Sacramento and the San Joaquin rivers is less than or equal to 2.64 mmhos/cm (Collinsville station C2). If the best available estimate of the Eight River Index (described in footnote 10) for January is more than 900 TAF, the daily average or 14-day running average EC at station C2 shall be less than or equal to 2.64 mmhos/cm for at least one day between February 1 and February 14; however, if the best available estimate of the Eight River Index for January is between 650 TAF and 900 TAF, the Executive Director of the State Water Board shall decide whether this requirement applies. If the best available estimate of the Eight River Index for February is less than 500 TAF, the standard may be further relaxed in March upon the request of the DWR and the USBR, subject to the approval of the Executive Director of the State Water Board. The standard does not apply in May and June if the best available May estimate of the Sacramento River Index (described in footnote 5) for the water year is less than 8.1 MAF at the 90% exceedance level. Under this circumstance, a minimum 14-day running average flow of 4,000 cfs is required in May and June. Additional Delta outflow objectives are contained in Table 4.

[12] The 7-day running average shall not be less than 1,000 cfs below the monthly objective.

[13] Partial months are averaged for that period. For example, the flow rate for April 1-14 would be averaged over 14 days. The 7-day running average shall not be less than 20% below the flow rate objective, with the exception of the April 15-May 15 pulse flow period when this restriction does not apply.

[14] The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley Water Year Hydrologic Classification (see Figure 3) at the 75% exceedance level. The higher flow objective applies when the 2-ppt isohaline (measured as 2.64 mmhos/cm surface salinity) is required to be at or west of Chipps Island.

[15] This time period may be varied based on real-time monitoring. One pulse, or two separate pulses of combined duration equal to the single pulse, should be scheduled to coincide with fish migration in San Joaquin River tributaries and the Delta. The USBR will schedule the time period of the pulse or pulses in consultation with the USFWS, the NOAA Fisheries, and the DFG. Consultation with the CALFED Operations Group established under the Framework Agreement will satisfy the consultation requirement. The schedule is subject to the approval of the Executive Director of the State Water Board.

[16] Plus up to an additional 28 TAF pulse/attraction flow during all water year types. The amount of additional water will be limited to that amount necessary to provide a monthly average flow of 2,000 cfs. The additional 28 TAF is not required in a critical year following a critical year. The pulse flow will be scheduled by the DWR and the USBR in consultation with the USFWS, the NOAA Fisheries and the DFG. Consultation with the CALFED Operations Group established under the Framework Agreement will satisfy the consultation requirement.

[17] Combined export rate for this objective is defined as the Clifton Court Forebay inflow rate (minus actual Byron-Bethany Irrigation District diversions from Clifton Court Forebay) and the export rate of the Tracy pumping plant.

[18] This time period may be varied based on real-time monitoring and will coincide with the San Joaquin River pulse flow described in footnote 15. The DWR and the USBR, in consultation with the USFWS, the NOAA Fisheries and the DFG, will determine the time period for this 31-day export limit. Consultation with the CALFED Operations Group established under the Framework Agreement will satisfy the consultation requirement.

[19] Maximum export rate is 1,500 cfs or 100% of the 3-day running average of San Joaquin River flow at Vernalis, whichever is greater. Variations to this maximum export rate may be authorized if agreed to by the USFWS, the NOAA Fisheries and the DFG. This flexibility is intended to result in no net water supply cost annually within the limits of the water quality and operational requirements of this plan. Variations may result from recommendations of agencies for protection of fish resources, including actions taken pursuant to the State and federal Endangered Species Act. Any variations will be effective immediately upon notice to the Executive Director of the State Water Board. If the Executive Director does not object to the variations within 10 days, the variations will remain in effect. The Executive Director of the State Water Board is also authorized to grant short-term exemptions to export limits for the purpose of facilitating a study of the feasibility of recirculating export water into the San Joaquin River to meet flow objectives.

[20] Percent of Delta inflow diverted is defined in Figure 4. For the calculation of maximum percent Delta inflow diverted, the export rate is a 3-day running average and the Delta inflow is a 14-day running average, except when the Central Valley Project or the State Water Project (SWP) is making storage withdrawals for export, in which case both the export rate and the Delta inflow are 3-day running averages.

[21] The percent Delta inflow diverted values can be varied either up or down. Variations are authorized subject to the process described in footnote 19.

[22] If the best available estimate of the Eight River Index (described in footnote 10) for January is less than or equal to 1.0 MAF, the export limit for February is 45% of Delta inflow. If the best available estimate of the Eight River Index for January is greater than 1.5 MAF, the February export limit is 35% of Delta inflow. If the best available estimate of the Eight River Index for January is between 1.0 MAF and 1.5 MAF, the DWR and the USBR will set the export limit for February within the range of 35% to 45%, after consultation with the USFWS, the NOAA Fisheries and the DFG. Consultation with the CALFED Operations Group established under the Framework Agreement will satisfy the consultation requirement.

[23] For the November-January period, close Delta Cross Channel gates for a total of up to 45 days. The USBR will determine the timing and duration of the gate closure after consultation with the USFWS, the NOAA Fisheries and the DFG. Consultation with the CALFED Operations Group established under the Framework Agreement will satisfy the consultation requirement.

[24] For the May 21-June 15 period, close the Delta Cross Channel gates for a total of 14 days. The USBR will determine the timing and duration of the gate closure after consultation with the USFWS, the NOAA Fisheries and the DFG. Consultation with the CALFED Operations Group established under the Framework Agreement will satisfy the consultation requirement. Gate closures shall be based on the need for the protection of fish. The process for approval of variations shall be similar to that described in footnote 19.