February 29, 2008

Ms. Karen Larsen
Central Valley Water Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670

Subject: Regional Water Board Actions to Protect Beneficial Uses in the Sacramento-San Joaquin Delta

Dear Ms. Larsen:

The State Water Contractors (SWC) appreciates the opportunity to comment on the Staff Report for the Central Valley Water Board Actions to Protect Beneficial Uses of the Sacramento-San Joaquin Delta. The SWC is a non-profit association of 27 public agencies from Northern, Central, and Southern California that purchase water under contract from the California State Water Project (SWP).[1] The SWP is the state's largest water delivery system, and collectively, members of the SWC deliver SWP water to more than 25 million residents throughout the state and more than 750,000 acres of highly productive agricultural land.

The SWC have been actively involved in Delta issues through the Bay-Delta Conservation Plan, the Delta Vision process, the Pelagic Organism Decline (POD) special studies, and a myriad of other forums. We strongly believe that the decline of pelagic species is the result of multiple stressors including contaminants, invasive species, in-Delta diversions, and predators. We applaud the Regional Water Board for taking action to address contaminant sources in the Delta.

[1] The members of the SWC are: Alameda County Flood Control and Water Conservation District Zone 7, Alameda County Water District, Antelope Valley-East Kern Water Agency, Casitas Municipal Water District, Castaic Lake Water Agency, Central Coast Water Authority, City of Yuba City, Coachella Valley Water District, County of Kings, Crestline-Lake Arrowhead Water Agency, Desert Water Agency, Dudley Ridge Water District, Empire-West Side Irrigation District, Kern County Water Agency, Littlerock Creek Irrigation District, Metropolitan Water District of Southern California, Mojave Water Agency, Napa County Flood Control and Water Conservation District, Oak Flat Water District, Palmdale Water District, San Bernardino Valley Municipal Water District, San Gabriel Valley Municipal Water District, San Gorgonio Pass Water Agency, San Luis Obispo County Flood Control and Water Conservation District, Santa Clara Valley Water District, Solano County Water Agency, Tulare Lake Basin Water Storage District.

Comprehensive Regional Monitoring Program

SWC supports the development of a Comprehensive Regional Monitoring Program for the Central Valley. However, development of a long-term comprehensive program should not divert resources from the immediate priority of identifying the role of contaminants in the pelagic organism decline. As we proposed in our January 11, 2008 letter to the State Water Resources Control Board (attachment 1), an initial step for the State and Regional Boards should be to complete a synthesis of the existing contaminant and toxicity monitoring data and monitoring programs. This initial synthesis of existing information would be useful for the design and implementation of a comprehensive monitoring program, as well as to further inform the design of focused studies for the POD. We commend the State Water Board for contracting with UC Davis to conduct this synthesis and urge the State and Regional Boards to provide adequate resources to complete this project in a timely manner.

One advantage of a comprehensive regional monitoring program is its ability to identify trends that then direct more focused special studies. The decline of the pelagic species in recent years is one such trend that now requires focused studies to help explain. The SWC made several specific recommendations for special studies relative to the POD in our January 11, 2008 letter to the State Board. They are:

1. The Board should undertake studies to investigate the relative sensitivity of the POD species, and the POD food web to the contaminants and contaminant mixtures that previous investigations have already detected in the Delta.

2. The Board should include in-situ analyses to capture the effects of sporadic contamination. It should also include evaluations on Delta species of concern that may be more sensitive than the standard test species that are used in laboratory analyses.

3. The Board should undertake (or, fund) investigations of the link between sediment contamination and possible effects on pelagic organisms either through food web transfers or through re-suspension of sediments during storm and wind events.

4. The Board should investigate (or, fund) additional investigations on the effect of metals and other contaminants on Delta pelagic and anadromous fish olfactory response.

5. The Board should undertake (or, fund) additional studies of the concentrations of endocrine disrupting chemicals in the Delta, as well as of the impacts of these chemicals on aquatic organisms.

6. The Board should begin to require wastewater treatment plants seeking to increase their capacity to evaluate the effect of their expansion on pelagic species residing downstream.

7. The Board should require that wastewater treatment plants increase their monitoring of ammonia, pH and temperature in their effluent and at several points in the receiving water. Improved monitoring should include increased monitoring frequency and spatial coverage, especially in the immediate vicinity of the outfall. The Board should also require additional fish toxicity testing by these dischargers to better quantify the effect of ammonia discharges on Delta fish species.

8. The Board should support, by providing necessary staff and funding an integrated and comprehensive biomarker investigation.

The management framework of any regional monitoring program needs the flexibility for adapting to changing priorities and new information. Over time the list of priority pollutants is likely to evolve and the need for additional special studies is likely to be identified. The management framework must be able to respond quickly to these changing needs.

The goals and objectives of a regional monitoring program also needs to be responsive to new information and priorities. The immediate goal should be identification of the role of contaminants in the pelagic organism decline. A long-term goal should be identification of trends that threaten beneficial uses. Program objectives should be to determine sources of contamination and to facilitate implementation and enforcement of source control measures.

The SWC provides more than 6 million in annual funding for the Interagency Ecological Program monitoring. In addition, several members of the SWC and Contra Costa Water District contribute $3.1 million per year to fund the Department of Water Resources (DWR) Municipal Water Quality Investigation Program. The Regional Water Board should work closely with both of these programs to ensure that the regional monitoring program data collection and format is compatible with these efforts.

Monitoring to Characterize Discharges from Delta Islands

The SWC support the Regional Water Board monitoring discharges from Delta Islands. We urge the Regional Water Board not to focus solely on agriculture in their characterization of discharges from Delta Islands, but to also consider contamination from urban areas within and around the Delta. It is critical to collect information on constituent concentration as well as volume of discharge and diversion. In addition to monitoring for pyrethroid pesticides, the Regional Water Board should monitor for other pesticides, metals, and endocrine disrupting chemicals, as well as for drinking water constituents of concern.

The SWC also agrees, as stated in the Regional Board staff report, that there is a need to better understand the quantity, timing, location and quality of discharges from Delta islands. To meet this need, the SWC recommends that the timing and volume of both diversions onto and discharges from the Delta islands should be monitored. In this effort the Regional Board should coordinate with DWR to ensure information is collected that will support updating the Delta Island Consumptive Use model, an important tool for studying Delta water quality.

Assess the Potential Impact of Ammonia on Delta Species

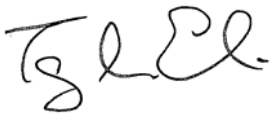
The SWC supports the Regional and State Board's efforts to understand the role of ammonia in primary productivity inhibition and direct toxicity to Delta aquatic organisms. We commend the Regional and State Boards for responding so quickly to new information with special studies to investigate the potential impact of ammonia in the Delta. The SWC urge the Regional and State Boards to provide sufficient funding and support to the special studies to ensure that the studies are designed to collect sufficient data to allow conclusions to be formed regarding the potential impact of ammonia of pelagic species. We welcome the opportunity to discuss the findings of these special studies and any follow-up action at a summit on the subject.

Determine the Need for Increased Enforcement of Additional Restrictions on in-Delta Pesticide Use

The SWC supports the Regional and State Board's efforts to encourage the Department of Pesticide Regulation (DPR) to expedite the pyrethroid pesticide re-registration process so that guidance on appropriate use and management practices can be developed in a timely manner. As the Regional Board continues to conduct toxicity and pesticide monitoring, we encourage you to consider both agricultural and urban sources of pesticides and work with DPR and other organizations to develop appropriate management measures to reduce the offsite movement of pesticides and reduce pesticide-related toxicity events.

The SWC appreciates the opportunity to provide input to the development of a strategic workplan addressing potential water quality problems in the Delta that may have impacts on pelagic species. We look forward to working with the Regional and State Boards as you develop the strategic workplan. If you have any questions, please contact me at (916) 447-7357 ext. 203.

Sincerely,



Terry L. Erlewine
General Manager
State Water Contractors

January 11, 2008

Tam Doduc, Chair
State Water Resources Control Board
P. O. Box 100
Sacramento, CA 95812

Re: Consideration of Pelagic Organism Decline in the San Francisco Bay / Sacramento-San Joaquin Delta Estuary

Dear Ms. Doduc:

In accordance with the State Board's Notice of Public Workshop, the State Water Contractors submit these written materials to provide information and specific recommendations regarding the Pelagic Organism Decline in the San Francisco Bay / Sacramento-San Joaquin Delta Estuary. Because of our long-held concern about the decline of pelagic species, we have been actively involved with the issue through the Bay-Delta Conservation Plan, the Delta Vision Process and as a party in the recent federal court OCAP litigation. Thus, we believe we have information and recommendations that may be particularly useful to the State Board as it considers how it can best assist the many other federal and state agencies that are currently investigating the multiple causes of and potential solutions for the pelagic organism decline.

INTRODUCTION

As the State Board is aware, a number of events relevant to the subject of pelagic organism decline have occurred subsequent to the Board's June 19, 2007 workshop on POD issues. These include the ongoing efforts to develop a Bay-Delta Conservation Plan and the recent release of the Delta Vision report. Chief among these recent activities, from a regulatory perspective, was a two-week trial in the United States District Court in the case of *Natural Resources Defense Council, et al. v. Dirk Kempthorne, et al*.; Case No. C:05-CV-1207 OWW. The trial involved the presentation of extensive expert testimony regarding the Delta smelt decline and a range of potential remedial measures related to State Water project and Central Valley Project operations that could be imposed during the interim period before a new biological opinion is issued by the United States Fish and Wildlife Service with respect to SWP and CVP operations.

The trial took place in August 2007 and resulted in lengthy Findings of Fact and Conclusions of Law and a related Interim Remedial Order issued by the federal court on December 14, 2007. Copies of these two documents are attached as Exhibits 1 and 2. Several key concepts are immediately apparent from a review of the Court's determinations. First, the Court recognized that the pelagic species before it – the Delta smelt – *is* in a state of serious decline and faces the possibility of extinction. Exh. 2, pp.4-5. As the Court found, "It is undisputed that the current status of the Delta smelt is serious." *Id*. Second, the Court recognized that the decline "is the result of multiple factors." *Id*., p. 5. According to the Court, these factors include (1) the presence of toxic materials (such as pesticides) in the Delta; (2) an overall reduction in the abundance of zooplankton that are a food source for

pelagic species; (3) the introduction and propagation of invasive species, including the Asian Overbite Clam (*Corbula*), a second freshwater clam (*Corbicula*) and the invasive Inland Silverside; (4) unscreened agricultural diversions in the Delta; (5) power plant diversions, including diversions for consumptive use and for cooling water; (6) modifications to the hydrology of the Delta; and (7) operations of the SWP, the CVP and other water diversions in the Delta. Exh. 2, p. 5. Finally, in its Remedial Order, which will remain in effect until a new OCAP biological opinion is issued by the USFWS, the Court took steps to limit the impact of only *one* of these multiple factors; *viz*., SWP and CVP operations. It did so by imposing substantial, new requirements upon the operation of both Projects. The Court could not – and did not – impose duties, limitations or restrictions related to the other causes of the pelagic organism decline it identified for the simple reason that it lacked jurisdiction to do so. It had only the operations of the SWP and CVP before it.

With respect to the SWP and CVP, the federal court's Remedial Order imposes new requirements that are intended to protect Delta smelt pending the issuance of a new biological opinion of the USFWS. These requirements are mandatory and significantly expand the obligations of the Bureau of Reclamation and the Department of Water Resources to monitor for the presence of larval and juvenile smelt in the Delta. Exh. 1, pp. 3-5. The Court's Remedial Order also imposes substantial new restrictions on reverse flows in Old and Middle Rivers (OMR) that are intended to reduce the entrainment of smelt. *Id*., pp. 5-8. These OMR flow restrictions have the effect of dramatically reducing SWP and CVP exports compared with prior flow and export limitations imposed upon the Projects by Water Right Decision 1641.[1] According to recent estimates by DWR, the impact of the federal Court's decision upon the 25 million Californians who receive water from the SWP will range between a 10% and a 30% reduction in water supplies in 2008 compared to operations under D-1641, depending upon actual hydrology and the location of Delta smelt spawning and rearing. By any reckoning, these reductions will have substantial adverse effects upon the millions of Californians who rely upon the SWP and CVP to provide water for their homes, their farms and their businesses. Depending upon actual hydrologic conditions in 2008, they have the potential to result in extensive water rationing, the fallowing of valuable agricultural lands, substantial job losses, and significant impacts to the State's economy.

[1] In D-1641, the State Board required DWR and Reclamation to comply with the requirements of the federal ESA. Specifically, as Condition 7 imposed upon the permits issued for both the SWP and CVP, the Board provided:

> This permit does not authorize any act which results in the taking of a threatened or endangered species or any act which is now prohibited or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). If a "take" will result from any act authorized under this water right, the permittee/licensee shall obtain authorization for an incidental take prior to construction or operation of the project. Permittee / Licensee shall be responsible for meeting all requirements of the applicable Endangered Species Act for the project authorized under this permit/license.

D-1641, p. 148.

The State Water Contractors share the federal court's view that the decline of pelagic species is the result of multiple causes. On June 28, 2007, well before the trial in *NRDC v. Kempthorne*, we wrote to the Director of the Department of Fish and Game and the California-Nevada Operations Manager of the USFWS, urging them to recognize that the decline of Delta pelagic species is caused by multiple factors including toxic point and non-point source discharges from lands within the Delta, in-Delta diversions unrelated to the SWP and CVP, and imported exotic species and predation by competitive species such as striped, small-mouth and large-mouth bass. We noted that their agencies had done little to determine the sources and impacts of *any* of these other stressors of pelagic species and we requested them to publish or otherwise make available the documentation, monitoring data, and other relevant information they have in their possession relating to the take of Delta smelt incidental to non-Project, in-Delta diversions. We also requested the USFWS and CDFG to implement a monitoring and reporting program so that the sources and effects of those other stressors could be known more clearly. A copy of our letter is attached as Exhibit 3. To date, neither agency has provided the requested data or initiated any of the requested monitoring or reporting programs. Our letter to the USFWS and CDFG also asserted the following:

> A more holistic approach is needed to provide meaningful protection for Delta smelt and other pelagic fish species in the Delta. Simply turning the knob tighter on the pumping plants of the SWP and CVP, which are already the subject of intense scrutiny by the state and federal courts and fishery agencies, is not the answer.
>
> Exh. 3, p. 2.

We believe that statement is even truer today than when it was written. The Remedial Order issued by the federal court on December 14, 2007, limits SWP and CVP operations to the maximum extent consistent with the evidence adduced at trial and carves out a regulatory exception only for public health and safety. It engages in no balancing of competing beneficial uses of the water made available for consumptive purposes by the SWP and CVP. Exh. 1, p. 10. As described more fully below in our response to matter # 4 from the Board's Notice of Workshop, recent work by an eminent ecological statistician, Dr. Bryan Manly, indicates that the Court-imposed restrictions on flows in Old and Middle Rivers are generally more stringent than what is actually required to eliminate most entrainment of Delta smelt in the export facilities. Meanwhile, the *other* factors causing the decline of pelagic species are effectively left unregulated. Thus, while the operations of the SWP and CVP have been subjected to intense scientific scrutiny and have been further regulated by the imposition of strict flow limitations in Old and Middle Rivers, other municipal and agricultural diversions that impact OMR flows have no pelagic species-related restrictions at all. Similarly, while the SWP and CVP are now obliged to monitor for larval and juvenile smelt throughout much of the year, more than 2,000 other in-Delta diverters face no pelagic species-related monitoring requirements of any kind. Indeed, while the Court recognized that other in-Delta export operations, in-Delta toxic discharges and unscreened in-Delta agricultural diversions are among the factors that have contributed to the decline of the Delta smelt (Exh. 2, p. 5) *not one* of those other in-Delta stressors has been

subjected to the kind of judicial and administrative focus faced by the SWP and CVP and *none* have been regulated for the purpose of reducing their impact upon pelagic species. [2]

The result is the emergence of a gross regulatory imbalance among the factors that are believed to contribute to the decline of pelagic species: SWP and CVP operations are now highly regulated, through D 1641[3], the 1995 Bay/Delta Water Quality Control Plan and the recently issued Order of the federal district court, while the operations of other Delta diverters – municipal, agricultural and industrial – and Delta dischargers are not restricted and *have never been examined* to determine the measures needed to minimize their contribution to the decline of pelagic species. While the Water Quality Control Plan and D-1641 contain measures to *protect* in-Delta agriculture, in-Delta municipal diversions and certain in-Delta non-native species such as striped and other species of bass, those documents have never enquired about the impacts of these water uses (and, invasive species) upon the native pelagic species.

This regulatory imbalance ill serves the pelagic species and the Board can now begin to correct it. As the federal court also recognized, there is scientific uncertainty regarding the *cause* of the recent decline of the smelt, which "continues to not be fully understood". *Id*. Similarly, the Court found the *effects* of the various causative factors on the Delta smelt and their relative magnitude are "not fully understood" and are subject to "scientific uncertainty". Exh. 2, p. 6. The State Contractors agree with these findings. They also believe that the State of California – acting through this Board – is well placed to true up the regulatory balance among the factors contributing to the decline of pelagic species. Stated differently, placing more regulatory limitations upon the operations of the SWP and CVP – whose operations have already been thoroughly examined and limited in terms of their impact upon pelagic species – will do little good for pelagic species when other in-Delta factors contributing to the POD continue to operate without any critical examination whatsoever and without any administrative effort to minimize their impact upon native pelagic species. We urge the Board to use this Workshop to begin that examination and take up its regulatory tools to address the many other actions and actors that are contributing to the status of the pelagic organisms.

In the material that follows, we offer the information we possess and our recommendations for action regarding matters 2, 3, 4 and 6 identified in the Board's Notice of Public Workshop.

---

[2] In the Environmental Impact Report it issued in connection with D-1641, the State Board recognized that the thousands of *other* in-Delta diversions collectively pump at a rate roughly equivalent to that of the CVP's Jones Pumping Plant. Final EIR for Implementation of the 1995 Bay/Delta WQCP Vol. 1, p. III-23.

[3] As noted above in footnote 1, in D-1641, the Board expressly made the SWP and CVP responsible for meeting all requirements of the federal and State Endangered Species Acts. D-1641, Condition 7, p. 148. And, the Project operators are doing so. In the unlikely event the operators of either Project fail to meet the obligation imposed by the Condition, the Board may take steps to enforce it. To our knowledge, no other in-Delta diverter or discharger operates under a similar requirement.

WORKSHOP ISSUE NO. 2 – INFORMATION REGARDING TOXICOLOGICAL STUDIES RELATED TO THE POD

Numerous sampling programs have detected pesticides in Sacramento-San Joaquin Delta water and sediment samples, occasionally at toxicologically relevant concentrations and often with multiple other pesticides that in combination could be toxicologically relevant. However, while investigators have conducted sampling, there has been no effort to pull the existing data together to develop a comprehensive spatial and temporal evaluation of contamination in the Delta's waterways. Nor has there been any effort to determine gaps where additional data need to be collected. In keeping with the provisions of State Board Resolution 2007-0079 (including paragraphs 7, 9 and 12) as well as efforts pursued by Central Valley Regional board staff, the State Contractors recommend that the Board prepare a synthesis of the existing pesticide monitoring data to help inform the design and implementation of a comprehensive monitoring program for water and sediment samples throughout the Delta. The program should be designed to determine sources of contamination and to facilitate implementation and enforcement of source control measures.

Monitoring data from May 2004 to October 2006 for the Irrigated Lands Program from the Coalition Group Monitoring, University of California and Surface Water Ambient Monitoring Program (SWAMP), exceeded the Central Valley Regional Board's triggers for pesticides at 57% of the sites tested on at least one occasion.

Zone	Pesticides Detections		
	Number of sites exceeding trigger level for at least one pesticide on one occasion	Total number of sites tested	Percent of sites exceeding trigger level at least once
Zone 1	23	57	40.4%
Zone 2	28	46	60.9%
Zone 3	40	55	72.7%
Total Zone 1-3	91	159	57.2%

Table compiled from data within CVRWQCB, 2007.

More recently, Guo, et al., 2007, reported the results of monitoring in the Sacramento River and its tributaries for 26 pesticides following a storm event in January 2005. Five pesticides and one pesticide degradate were detected. Diuron, diazinon and simazine were found in every stream sampled. Diazinon concentrations in the Feather River and Colusa Basin Drain exceeded the water quality criterion of 0.16 ug/l.

Smalling, et al., 2007, analyzed water and sediment samples from the Yolo Bypass and the five areas draining into it for 27 and 41 pesticides, respectively. Thirteen current use pesticides were detected in surface water samples, and 13 in sediment samples. Simazine and hexazinone were detected in all areas, including 2,500 ng/l hexazinone in Willow Slough. Thiobencarb and trifluralin were detected in 80% of the sediment and suspended sediment samples with concentrations as high as 24 ug/kg each. Oxyfluorfen was detected at 50 ug/kg in suspended sediment from Willow Slough.

Kuivila, et al., 2002, sampled fifty-four water samples in spring and summer 2000 from Delta smelt habitat. All samples contained from 3 to 12 different pesticides. Metolachlor was detected in 91% of samples, molinate in 83% and thiobencarb in 76%. Similar results were obtained in 1998 and 1999. Similarly, Amweg, et al., 2006, sampled sediments from 15 urban creeks in and around Sacramento and the East Bay and every sample had detectable pyrethroids.

While many of the detected pesticides are near or below known lethal and effect concentrations for standard test organisms, there is no information on the effect level of many of the pesticides or on the effect of the mix of pesticides detected in many of the Delta samples. In addition, very little is known about Delta smelt sensitivity to contaminants, except that for the few contaminants tested they seem to be significantly more sensitive than standard test species. For example, Werner, 2005, found that 3-month old Delta smelt are 10-12 times more sensitive to copper than 3-month old striped bass. Werner also found that Delta smelt may be more sensitive to unionized ammonia than other fish species. Even less is known about the sensitivity of the copepods they feed on. The State Contractors believe the Board should undertake (or fund) additional studies to investigate the relative sensitivity of the POD species, and the organisms they feed on, to the pesticides and pesticide mixtures that the investigators described above have already found in the Delta.

Significant evidence also exists that water column and sediments within the Sacramento-San Joaquin Delta cause acute and chronic toxicity to standard test species. Monitoring from May 2004 to October 2006 for the Irrigated Lands Program from the Coalition Group Monitoring, University of California and Surface Water Ambient Monitoring Program (SWAMP), showed significant toxicity to at least one test species at 59% of the sites tested on at least one occasion.

Species tested	Number of sites with at least one toxic	Number of sites tested	Percent of sites with at least one toxic sample
Pimephales promelas	26	186	14.0%
Ceriodaphnia dubia	69	185	37.3%
Selenastrum capricornutum	60	157	38.2%
Hyalella azteca	54	139	38.8%
All species combined	119	201	59.2%

Table compiled from data within CVRWQCB, 2007.

In addition, Werner, 2005, and Werner, et al., 2006, 2007a, and 2007b, tested water samples from 15 locations within the Delta and found significant mortality in 10-day tests with *Hyalella azteca* at 11 of the sites on at least one occasion. The sample locations and timing of sampling were selected based on known distribution patterns of the pelagic organism decline species of concern.

Department of Fish and Game sites with significant mortality observed in 10-day test with *Hyalella azteca*

Date	323	340	405	504	508	602	609	704	711	Light 55	804	812	902	910	915
8/10/2005		X													
9/7/2005		X													
1/25/2006	X*														
7/11/2006	X														
7/27/2006	X	X													
8/22/2006									X*						
2/1/2007										X				X	
2/28/2007									X*						
3/30/2007								X*							
4/12/2007									X*						
7/10/2007			X	X*	X*	X					X*				
7/25/2007		X*													
8/8/2007			X*												
8/22/2007			X												
8/23/2007									X						

* Toxicity observed with addition of piperonyl butoxide (PBO)

Werner 2005 and Werner, et al., 2006, 2007a, and 2007b also found growth / biomass effects on *Hyalella azteca* after 10-days exposure in 14 of the 15 sites tested.

Department of Fish and Game sites with significant growth/biomass effect observed in 10-day test with *Hyalella azteca*

Date	323	340	405	504	508	602	609	704	711	Light 55	804	812	902	910	915
6/13/2005									X				X	X	
8/10/2005		X													
9/7/2005		X													
3/20/2006				X*											
4/17/2006															X*
6/13/2006	X														
6/27/2006												X*			
7/11/2006	X*														
7/27/2006	X	X*													
8/22/2006							X*		X*	X*			X		
9/21/2006			X*	X*	X*										
10/4/2006									X*				X*	X*	
1/4/2007														X*	
1/17/2007				X*											
1/18/2007								X*							
2/1/2007														X*	X*
2/13/2007		X*								X*			X*		
3/1/2007					X*										X*
3/14/2007						X*	X*								
4/18/2007							X*								
5/23/2007					X*										
6/6/2007												X*	X*	X*	

*Growth/biomass effect observed with addition of piperonyl butoxide (PBO)

Moreover, significant toxicity has been observed in sediment samples collected from throughout the Delta. For example, Amweg, et al., 2006, tested sediment samples from the Sacramento area and found that 22 of the 33 samples caused significant toxicity to *Hyalella azteca* and 7 of the 8 creeks tested had toxic samples on at least one occasion. Pyrethroid concentrations were sufficient to explain the toxicity in 21 of the 22 toxic samples. Weston, et al., 2004, collected 70 sediment samples from the Central Valley. Forty-two percent of the sites caused significant mortality to *H. azteca* or *Chironomus tentans* on at least one occasion. Pyrethroids were detected in 75% of the samples. Given our growing understanding of the Delta smelt's preference for turbid water, the link between sediment contamination and POD needs to be explored further.

In a river system such as the Delta, contamination events can be sporadic and difficult to detect with grab samples. Investigators are now learning that even short duration exposures can have significant impacts on aquatic populations. For example, Oros, 2005, cites a study by Forbes and Cold (2005) that found that brief (1-hour) exposure to low levels of esfenvalerate during the early larval stage of midge can have measurable population level effects on larval

survival and development rates. Also, 30-minute pulse exposures to lambda-cyahalothrin increased the effect after each exposure. Ward, et al., 2008, found when juvenile killifish were exposed to 1.0 ug/l 4-nonylphenol for only 1-hour, unexposed killifish avoided them (disrupted their shoaling behavior). Shoaling is a predation avoidance behavior. Ward cites studies that detected 4-nonylphenol at concentrations from 0.5 to 343 ug/l near sewage outfalls. Investigators are also finding that contaminants below measurable effect levels can have additive and synergistic effects when combined with other contaminants or pathogens. For example, it is now well known that pyrethroid pesticides are more toxic to aquatic organisms when piperonyl butoxide (PBO) is also present. Oros, et al., 2005, cite findings by Wheelock (2004) that PBO can enhance the toxicity of pyrethroids by 10-150 times. PBO is added to many of the pyrethroid formulations on the market. In addition, Clifford, et al., 2005, found that juvenile Chinook salmon exposed to 0.1 ug/l esfenvalerate for 96-hours and to infectious hematopoietic necrosis virus had significantly higher mortality and died sooner than those exposed to either agent separately.

As with contaminant monitoring, numerous investigators have conducted analyses of aquatic toxicity caused by water and sediment samples within the Central Valley. The Board should undertake (or fund) the preparation of a synthesis of all the existing toxicity monitoring data to help inform the design and implementation of a comprehensive monitoring program for water and sediment samples throughout the Delta. Any program that is developed, should include in-situ analyses to capture the effects of sporadic contamination. It should also include evaluations on Delta species of concern and their preferred prey that may be more sensitive than the standard test species that are used in laboratory analyses. The Board should also undertake (or fund) investigations of the link between sediment contamination and possible effects on pelagic organisms either through food web transfers or through re-suspension of sediments during storm and wind events.

Contamination can have more subtle effects on population health as researchers have found. Fish olfactory systems are used for many critical functions including: finding prey, avoiding predators, schooling, finding mates, synchronizing spawning, and avoiding contamination. Sandahl, et al., 2004, measured reductions in olfactory response in coho salmon exposed to copper and chlorpyrifos for 7 days. The calculated concentration at which 50% of the fish were affected (EC50) was 11.1 ug/l for copper and 1.81 ug/l for chlorpyrifos. Esfenvalerate at 0.2 ug/l caused atypical postsynaptic burst activity in the olfactory bulb. Sandahl cites studies that detected copper in surface waters in Oregon up to 21 ug/l and chlorpyrifos in the Sacramento-San Joaquin River basin at 0.5 ug/l. In 2007, Sandahl, et al. found olfactory response in juvenile coho salmon exposed to 2 ug/l dissolved copper for 3-hours was reduced by 40%. This loss in olfactory sensitivity led to a failure to initiate predatory avoidance behaviors in response to chemical alarm cues. Sandahl cites recent monitoring in northern California following a storm event that detected copper at a mean concentration of 15.8 ug/l, ranging from 3.4 - 64.5 ug/l. He also cites two recent studies that indicate that dissolved copper also impacts fish lateral line neurons that provide cues for shoaling, prey capture and predator evasion. Raloff, et al., 2007, cites a study that found Coho salmon olfactory neuron activity was reduced after only 30-minutes exposure to 1 ug/l atrazine. These studies indicate that even very low doses of contamination can have significant impacts even with only short duration exposures. The Board should investigate (or, fund) additional investigations on the effect of metals and other contaminants on Delta pelagic and anadromous fish olfactory response.

In addition to the above studies of contaminant impacts, research on the effects of wastewater treatment plant effluent is beginning to link the impacts of these discharges to aquatic organisms living downstream. For example, Huang, et al., 2001, analyzed secondary wastewater effluent and detected concentrations of estrogenic hormones at levels that cause vitellogenesis in fish. Effluent from secondary wastewater treatment contained 2.75-4.05 ng/l 17β-estradiol and 1.54-2.42 ng/l 17α-ethinyl estradiol. Vitellogenesis in fish has been observed at concentrations greater than 1 ng/l. Sedlak, et al., 2007, (in-progress) cites a study by Williamson and May in 2002 that analyzed over 400 adult Chinook salmon collected from 13 locations in the Sacramento and San Joaquin River watersheds and found that up to 38% of the male Chinook salmon were feminized. Wastewater effluent can also have population level impacts as was observed by Kidd, et al., 2007. Kidd conducted a 7-year whole lake experiment that showed that chronic exposure of fathead minnows to 5-6 ng/l 17α-ethinyl estradiol (a synthetic estrogen) led to feminization of males, impacts on gonadal development, altered oogenesis in females, and near extinction of the species from the lake after only two year's exposure. The Board should undertake (or, fund) additional studies of the concentrations of endocrine disrupting chemicals in the Delta, as well as of the impacts of these chemicals on aquatic organisms. In addition, the Board should begin to require wastewater treatment plants seeking to increase their capacity to evaluate the effect of their expansion on pelagic species residing downstream.

Recent investigations by Mueller-Solger, DWR (pers. comm.), point to ammonia discharges from the Stockton wastewater treatment plant, combined with high pH levels in the San Joaquin River, as a suspect in the death of 116 acoustically tagged salmon released for the Vernalis Adaptive Management Program experiment in 2007. This is not conclusive due to a lack of the appropriate data. The Board should require that wastewater treatment plants increase their monitoring of ammonia, pH, and temperature in their effluent and at several points in the receiving water. Improved monitoring should include increased monitoring frequency and spatial coverage, especially in the vicinity of the outfall. The Board also should require additional fish toxicity testing by these dischargers to better quantify the effect of ammonia discharges on Delta fish species and the food web that supports them.

Finally, biomarkers are becoming a useful tool in the investigation of contaminant effects on aquatic organisms. Anderson 2007 conducted an expert panel review of biomarkers for the pelagic organism decline. The panel recommended a 3-4 year integrated and tiered investigation that focuses on two of the POD species. The investigation includes field and laboratory investigations of larval, juvenile and adult fish and several possible special studies. The Board should support, by providing necessary staff and funding, such an integrated and comprehensive investigation.

REFERENCES

1. Amweg, Erin L., Donald P. Weston, Jing You and Michael J. Lydy. 2006. *Pyrethroid Insecticides and Sediment Toxicity in Urban Creeks from California and Tennessee.* Environmental Science and Technology, 40(5): 1700-1706.

2. Anderson, Susan L. 2007. *Biomarkers and the Pelagic Organism Decline: Conclusions of the POD Biomarker Task Force, Fort Mason, San Francisco, August 29-30, 2007.*

3. Central Valley Regional Water Quality Control Board. 2007. *Revised Draft 2007 Review of Monitoring Data Irrigated Lands Conditional Waiver Program.* 13 July 2007. http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/monitoring_activity/index.html

4. Guo, Lei, Kevin Kelley, and Kean S. Goh. 2007. *Evaluation of sources and loading of pesticides to the Sacramento River, California, USA, during a storm event of winter 2005.* Environmental Toxicology and Chemistry 26(11):2274-2281.

5. Huang, Ching-Hua and David L. Sedlak. 2001. *Analysis of estrogenic hormones in municipal wastewater effluent and surface water using enzyme-linked immunosorbent assay and gas chromatography/tandem mass spectrometry.* Environmental Toxicology and Chemistry, 20(1):133-139.

6. Kidd, Karen A, Paul J. Blanchfield, Kenneth H. Mills, Vince P. Palace, Robert E. Evans, James M Lazorchak, and Robert W. Flick. 2007. *Collapse of a fish population after exposure to a synthetic estrogen.* PNAS, 104(21):8897-8901.

7. Kuivila, Kathryn M. and G. Edward Moon. 2002. *Exposure of Delta smelt to dissolved pesticides in 2000.* IEP Newsletter, 15(2):42-45.

8. Mueller-Solger, Anke. 2008. personal communications. Department of Water Resources.

9. Oros, Daniel R. and Inge Werner. 2005. *Pyrethroid insecticides: an analysis of use patterns, distributions, potential toxicity and fate in the Sacramento-San Joaquin Delta and Central Valley. White Paper for Interagency Ecological Program.* SFEI Contribution 415. San Francisco Estuary Institute, Oakland, CA.

10. Raloff, Janet. 2007. *Aquatic Non-Scents: Repercussions of water pollutants that mute smell.* Science News Online 171(4):59.

11. Sandahl, J.F., Baldwin, D.H., Jenkins, J.J., and Scholz, N.L. 2004. *Odor-evoked field potentials as indicators of sublethal neurotoxicity in juvenile coho salmon exposed to copper, chlorpyrifos, or esfenvalerate.* Canadian Journal of Fisheries and Aquatic Sciences, 61:404-413.

12. Sandahl, J.F., Baldwin, D.H., Jenkins, J.J., and Scholz, N.L. 2007. *A sensory system at the interface between urban stormwater runoff and salmon survival.* Environmental Science and Technology, 41:2998-3004.

13. Sedlak, David L., Daniel Schlenk, Robert Spies, Edward P. Kolodziej, Jorge E. Loyo-Rosales. 2007 in-progress. *Identifying the causes of feminization of Chinook salmon in the Sacramento and San Joaquin River System.* http://www.ce.berkeley.edu/~sedlak/CALFED website.htm

14. Smalling, Kelly L., James L. Orlando, and Kathryn M. Kuivila. 2007. *Occurrence of pesticides in water, sediment, and soil from the Yolo Bypass, California.* San Francisco Estuary and Watershed Science, 5(1):Article 2.

15. Ward, Ashley J.W., Alison J. Duff, Jennifer S. Horsfall, and Suzanne Currie. 2008. *Scents and scents-ability: pollution disrupts chemical social recognition and shoaling in fish.* Proceedings of the Royal Society B:Biological Sciences, 275(1630):101-105.

16. Werner, Inge. 2005. *Pelagic Organism Decline (POD): acute and chronic invertebrate and fish toxicity testing.* Progress Report, 30, September 2005.

17. Werner, Inge, Linda Deanovic, Juergen Geist, Dan Markiewicz, Kevin Reece, Lita Stephenson, and Marie Vasi. 2006. *Pelagic organism decline: acute and chronic invertebrate and fish toxicity testing.* Progress Report. Aquatic Toxicology Laboratory, School of Veterinary Medicine, University of California, Davis, California.

18. Werner, Inge, Linda Deanovic, Joy Khamphanh, Juergen Geist, Dan Markiewicz, Kevin Reece, Marie Stillway, and Susanne Brander. 2007a. *Pelagic organism decline: acute and chronic invertebrate and fish toxicity testing.* Progress Report II. Aquatic Toxicology Laboratory, School of Veterinary Medicine, University of California, Davis, California.

19. Werner, Inge, Linda Deanovic, Dan Markiewicz, Marie Stillway, Joy Khamphanh, Richard Connon, Nathan Offer, James Krause, and Tony Ha. 2007b. *Pelagic organism decline: acute and chronic invertebrate and fish toxicity testing.* Progress Report III. Aquatic Toxicology Laboratory, School of Veterinary Medicine, University of California, Davis, California.

20. Weston, D.P., J. You, and M.J. Lydy. 2004. *Distribution and toxicity of sediment-associated pesticides in agriculture-dominated water bodies of California's Central Valley.* Environmental Science and Technology, 38(10):2752-2759.

WORKSHOP ISSUE NO. 3 – THE SIGNIFICANCE OF SCIENTIFIC INFORMATION DERIVED FROM CRITICALLY LOW POPULATION LEVELS OF PELAGIC SPECIES

The ability to infer Delta smelt abundance trends and the relative impact of various sources of mortality on smelt deteriorates as fewer and fewer smelt are caught in the ongoing sampling (as more and more samples catch none). However, the deterioration in this ability to measure smelt distribution and population abundance is also partly an artifact of the sampling techniques. Different techniques such as the spring Kodiak trawl (SKT) or the Lampara net are orders of magnitude more efficient than the Fall Midwater Trawl (FMWT) at capturing smelt for the same volume of water sampled, as we will show below.

Effective management of Delta smelt and other pelagic species requires representative data regarding distribution and population, even at low abundances. Since that data can be gathered more effectively with different gear and sampling designs than are used presently, it is essential that the fish agencies immediately move to integrate or add sensitive and statistically valid sampling techniques and designs into their normal monitoring activities for all smelt life stages.

Data collected by the Department of Fish and Game during 1994 suggest that the FMWT is extremely inefficient at capturing pre-adult Delta smelt. In this study, the Interagency Ecological Program (IEP) ran nets side by side and compared the results. The results were that the Kodiak trawl and the Chipps Island trawl were much more efficient than the standard FMWT technique as shown in Figures 3.1 – 3.3.

This conclusion is reinforced by a comparison of smelt abundance estimates derived from FMWT data with smelt populations derived from SKT data.. Delta smelt have a one-year life cycle, although a few fish may live two years. Thus, the population is at its maximum abundance after spring spawning and necessarily drops continuously until the next crop of smelt is born the following spring. Winter abundance must be significantly less than abundance during the previous fall. Yet the SKT catch data leads to greater abundance estimates than does the FMWT routinely. This increase is unrealistic (assuming there is no immigration into the survey area). The SKT population estimates should be significantly lower than the FMWT population estimates. See Figures 3.4-7. Again, an inference to be drawn is that the FMWT is very inefficient compared to other sampling methods. [4]

One clear implication of these findings is that we are capable of gathering data on Delta smelt distributions and abundance that is far more robust than the data currently gathered. A second implication is that smelt abundances are probably significantly higher than previously believed. That is not to say that smelt populations have not declined significantly or that smelt are not at risk of extinction. As Figure 3.8 makes clear, even with the higher estimates of smelt populations generated using the SKT, populations are still down. But more effective management of smelt requires that the relative importance of various sources of mortality be properly evaluated and compared.

[4] Other fall collection efforts using a purse-seine-like Lampara net also catch many more Delta smelt than the FMWT. Dr. Sitts estimated and compared Delta smelt densities based on FMWT data and Lampara data collected by Department of Fish and Game and by the University of California at Davis researchers. All of these data were collected at similar times and locations in the lower Sacramento River. The FMWT densities for the lower Sacramento River ranged from 0 to 97 delta smelt/10af compared to 0-1,541 delta smelt/10af between the two Lampara programs in the same area. Annual average densities for the FMWT and two Lampara efforts were 8 and 209-372, respectively. Over 2000, 2002 and 2004-06, the annual average FMWT densities declined from 17 to 0, while the Lampara densities fluctuated between 224 and 576 delta smelt/10af. Although the Lampara sampling focuses on areas where Delta smelt are caught, it also samples the same areas as the less efficient FMWT. The Lampara technique is probably more accurate; however, more direct tests are recommended. Even in the absence of such tests, however, the existing data are sufficient to show that the ability to detect (catch) smelt at low abundances is much greater with the Lampara net, or spring Kodiak trawl than with the FMWT.

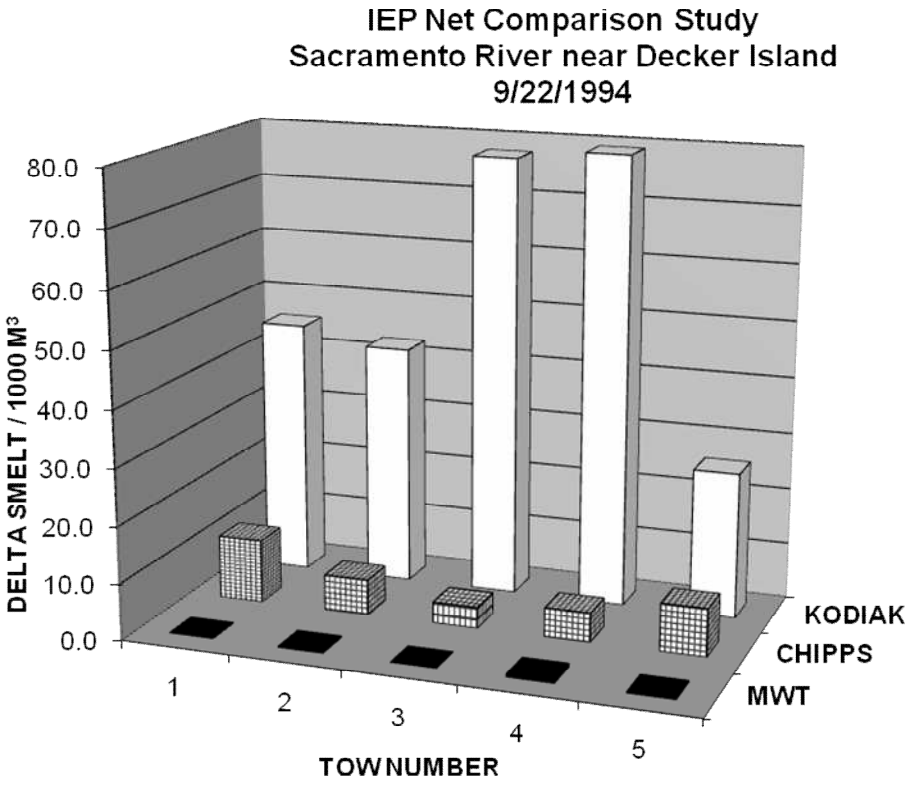


Figure 3.1. IEP Delta smelt catches/1,000 cubic meters sampled by the Fall Midwater Trawl (MWT), Chipps Island trawl (CHIPPS) and the Kodiak trawl (KODIAK) near Decker Island.

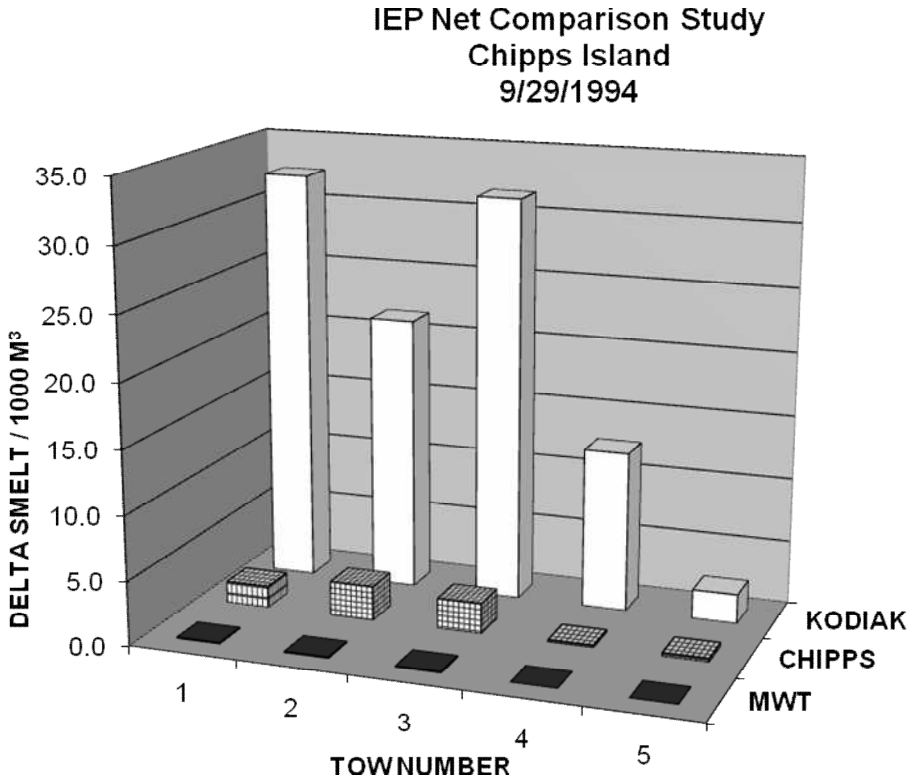


Figure 3.2. IEP Delta smelt catches/1,000 cubic meters sampled near Chipps Island by the Fall Midwater Trawl (MWT), Chipps Island Trawl (Chipps) and the Kodiak trawl. (Kodiak).

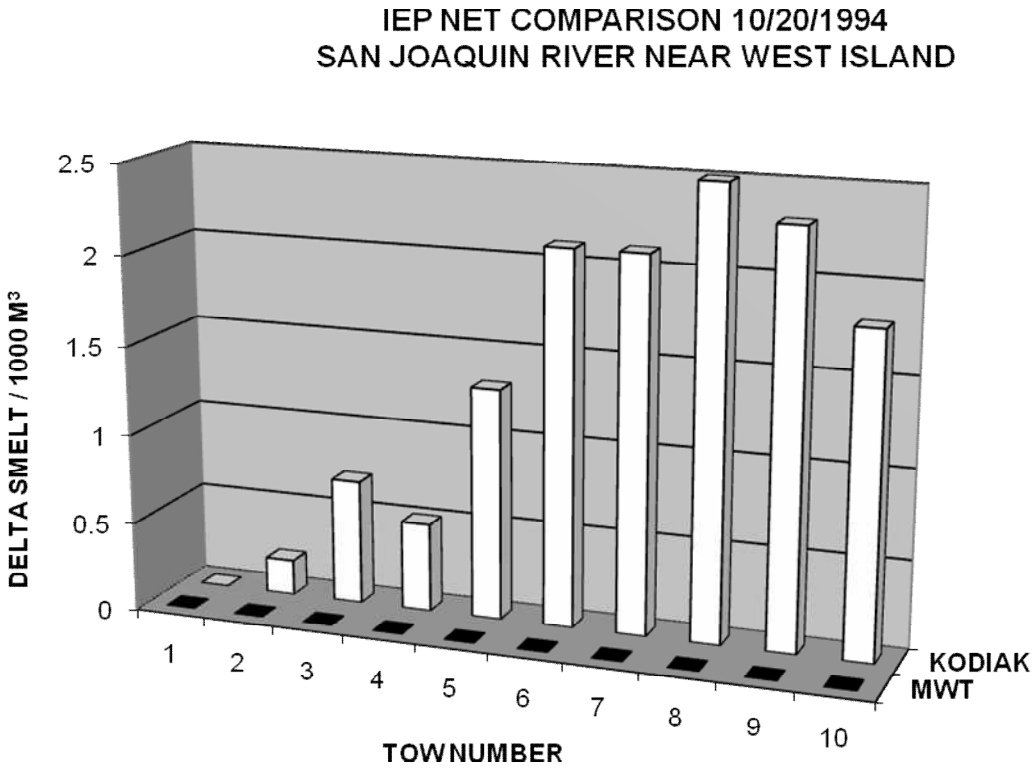


Figure 3.3. IEP Delta smelt catches/1,000 cubic meters sampled by the Fall Midwater Trawl (MWT) and the Kodiak trawl (Kodiak) near West Island.

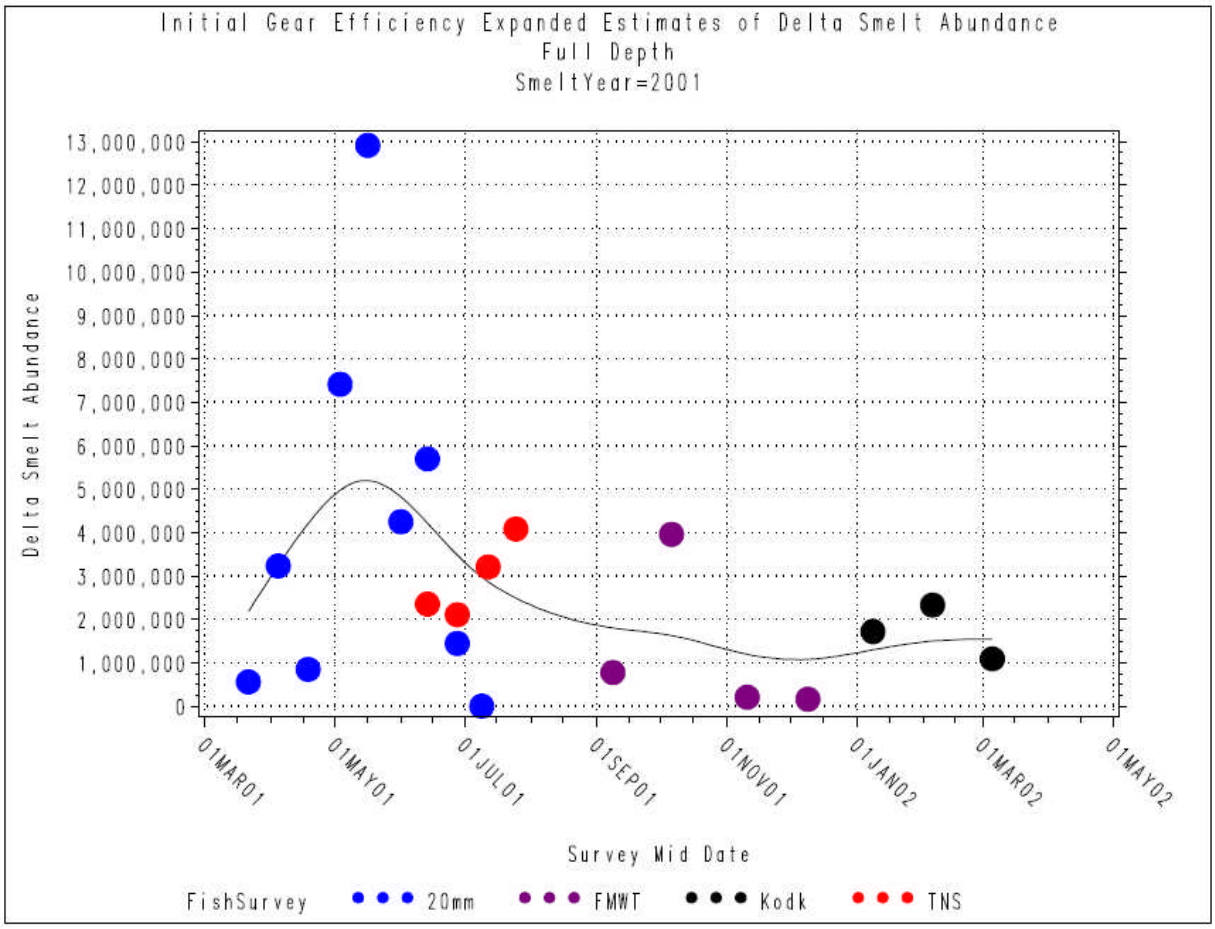


Figure 3.4. Delta smelt abundance estimates for 2001 and 2002. Fall estimates of pre-adult abundance based on the Fall Midwater Trawl (FMWT) are exceeded by abundance estimates for adults based on Kodiak trawl (Kodiak) sampling.

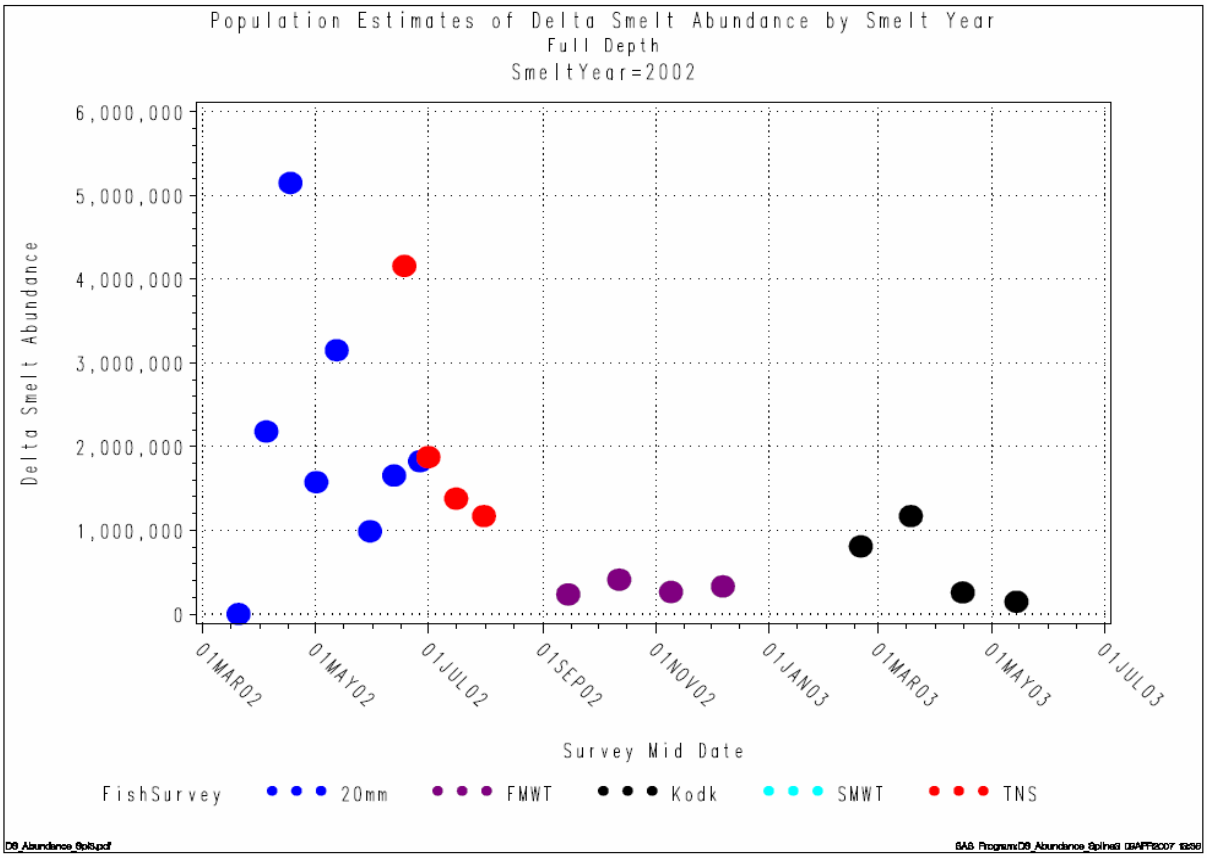


Figure 3.5. Delta smelt abundance estimates for 2002 and 2003. Fall estimates of pre-adult abundance based on the Fall Midwater Trawl (FMWT) are exceeded by abundance estimates for adults based on Kodiak trawl (Kodiak) sampling.

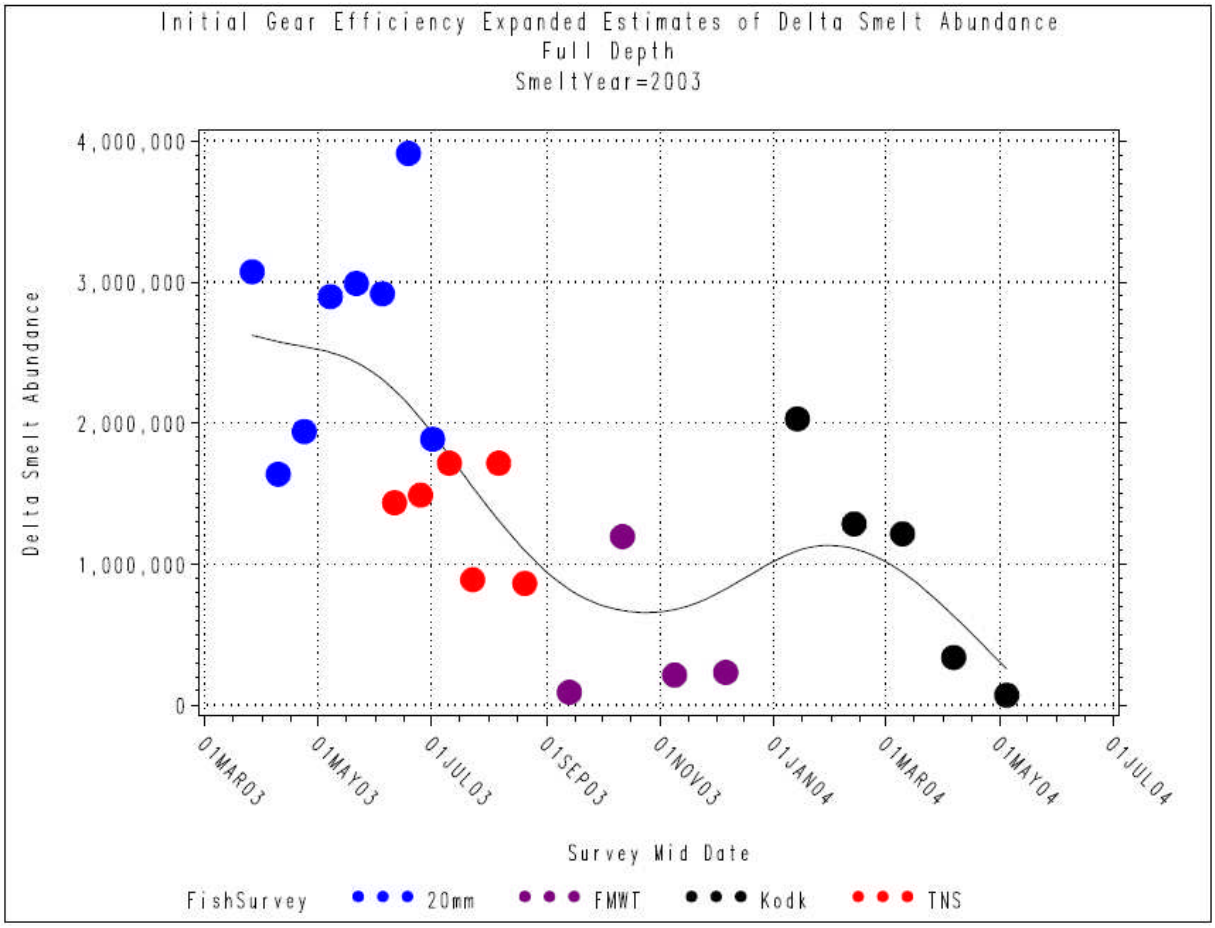


Figure 3.6. Delta smelt abundance estimates for 2003 and 2004. Fall estimates of pre-adult abundance based on the Fall Midwater Trawl (FMWT) are exceeded by abundance estimates for adults based on Kodiak trawl (Kodk) sampling.

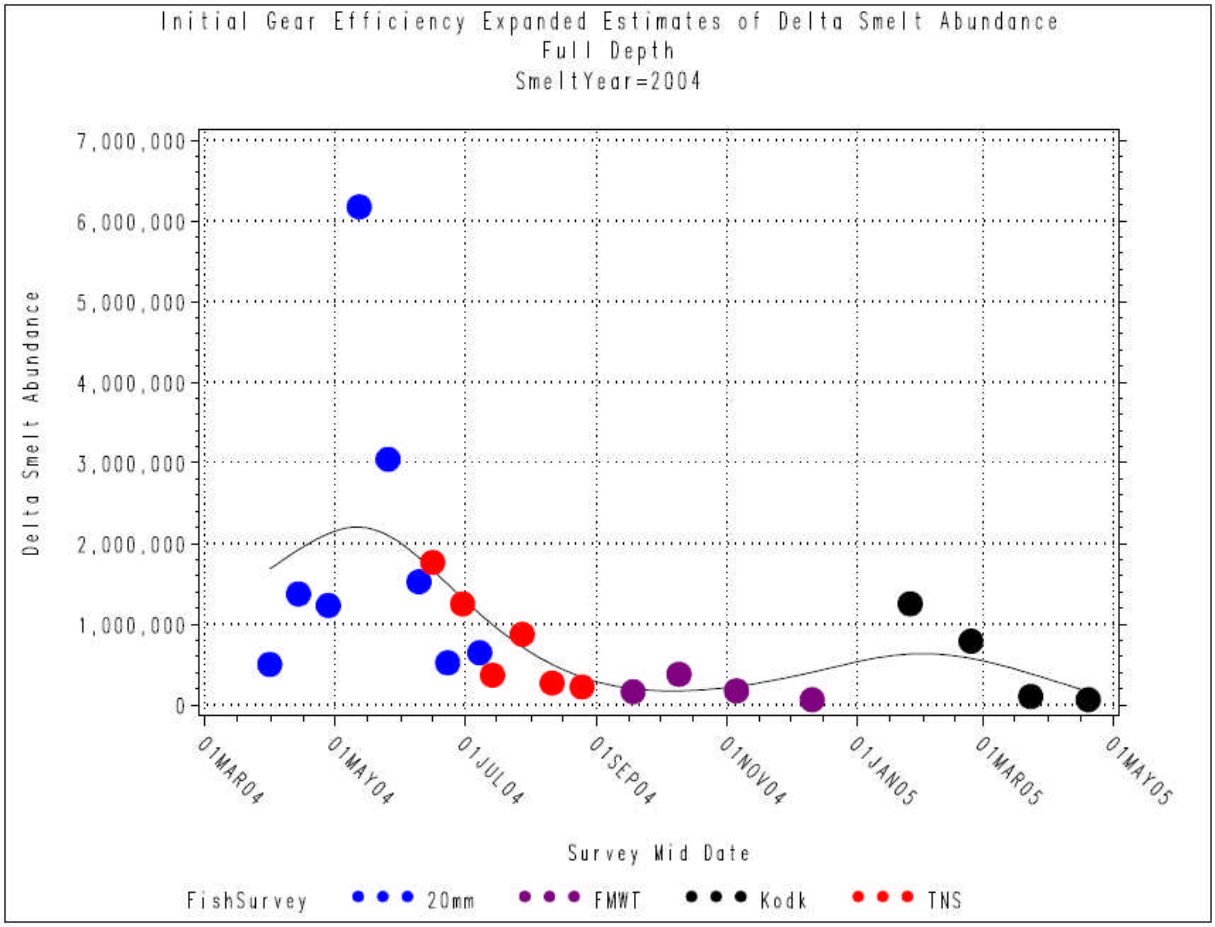


Figure 3.7. Delta smelt abundance estimates for 2004 and 2005. Fall estimates of pre-adult abundance based on the Fall Midwater Trawl (FMWT) are exceeded by abundance estimates for adults based on Kodiak trawl (Kodiak) sampling.

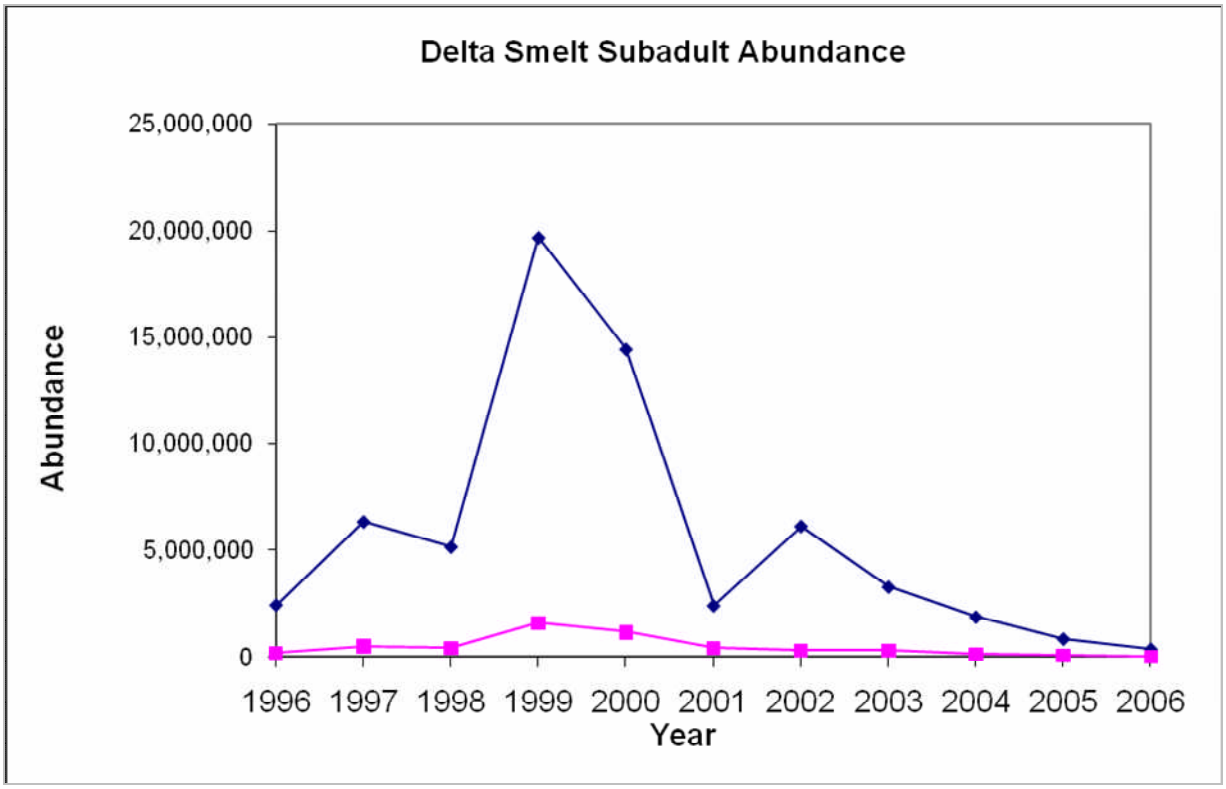


Figure 3.8. Fall Delta smelt abundances estimated two ways. The pink line shows abundance estimated using raw FMWT data. However, as discussed, the FMWT is very inefficient compared to other sampling techniques. The blue line is roughly what the population estimate would have been if a Kodiak Trawl had been performed in the fall instead of the standard FMWT.

WORKSHOP ISSUE NO. 4 – NEW FINDINGS RELATED TO THE EFFECTS OF WATER EXPORTS

Scientific understanding of the circumstances under which adult and juvenile smelt appear at the state and federal export pumps has improved dramatically during the past year. As early as 2006, the fish agencies understood that adult Delta smelt tend to show up at the export pumps immediately following large flow pulses on the Sacramento River. Moreover, Pete Smith of the United States Geological Survey ("USGS") had noted that the greater the reverse flow in Old and Middle Rivers (OMR), the greater the average salvage. These two observations led to SWP and CVP operating criteria for the winter of 2007 that limited OMR flows after three-day average Sacramento flows entering the Delta exceeded 25,000 cfs.

During 2007, David Fullerton of the Metropolitan Water District of Southern California ("MWD") and Pete Smith independently reached similar conclusions to explain the relationship between Sacramento flow, OMR flow and adult salvage. Adult Delta smelt are not commonly found in Delta water of low turbidity (turbidity below about 10 – 15 NTU). For the past two decades, turbidity in the south Delta has been extremely low during the fall and going into the winter (perhaps due to invasive plant species that trap sediment). Thus, while smelt were once

occasionally found in the FMWT surveys in the south Delta, no smelt have been detected in the south Delta in the fall since December 1980. Until this turbidity "desert" extending from around Jersey Point to the export pumps is breached during the winter by some source of turbidity, there is no chance whatsoever of significant Delta smelt salvage.

The turbidity desert is commonly breached during many winters by the combination of (1) large flow pulses on the Sacramento River (which carry heavy loads of sediment) and (2) large reverse flows in Old and Middle River. The turbidity reaches the San Joaquin side of the Delta via Georgiana Slough, Three Mile Slough and the confluence. The reverse flows occur because (1) flows on the San Joaquin River typically remain very low except during the wettest winters (because storage capacity on the San Joaquin tributaries is very large compared to normal runoff) and (2) export limits are defined by the 65% or 35% Export/Inflow standard, so higher inflow means more allowable exports.

Smelt swim with the turbidity as it moves from the Sacramento side of the Delta to the San Joaquin side. If the turbidity plume reaches the reverse flows of Old and Middle River, the turbidity and the smelt within the turbidity will soon reach the export pumps. There is some dispute whether these smelt are "migrating" or simply swimming within desirable habitat. In either case, the creation of a bridge of turbidity between the Sacramento River and the export pumps opens the door to salvage.

The increasing acceptance of this physical explanation for how salvage occurs is reflected in the recommendations presented to the court by the USFWS in *NRDC v. Kempthorne* and adopted by the court. In its decision, the federal court mandated the installation of three new turbidity monitors and that exports should be cut to reduce OMR flows should any of these monitors register turbidity greater than 12 NTU starting on December 25th. While a step forward, these criteria are very crude and are not likely to lead to efficient reduction in smelt entrainment (defined as major reductions in salvage at the lowest possible water cost). As an example, the Court's criteria ignore the need for a continuous band of turbidity extending to the Sacramento River before salvage can occur. Thus, exports were cut on December 28, 2007 as a result of a purely local turbidity spike at Holland Cut that posed little risk of salvage.

In the summer of 2007, MWD commissioned Dr. Bryan Manly, an eminent statistician with a long history of work on Bay- Delta issues, to perform a statistical analysis of smelt salvage. The goal was to explain the onset and magnitude of adult smelt salvage using measurable and predictable physical factors. Dr. Manly has succeeded in developing correlations that allow us to predict the onset and numerical magnitude of adult smelt salvage days in advance and, by controlling Old and Middle River flows, to limit adult smelt salvage to whatever level deemed appropriate at the lowest possible water cost. These correlations are described in the materials attached as Exhibits 4, 5 and 6.

The Manly correlations are consistent with previous observations that smelt salvage is associated with increased Sacramento River flow and that salvage increases as OMR flow becomes more negative. However, the equations also show that major salvage events only occur under particular, well defined circumstances that are easily avoided. Thus, salvage can be kept to *de-minimis* levels while allowing export levels that are significantly higher than those allowed in the Interim Remedial Order issued by the federal court.

Analysis by Manly to date has focused on salvage at Banks and Jones pumping plants during December – January. However, he is now developing correlations for the salvage of adults during February through March and for juvenile salvage in the spring.

The Manly equations can be put into a graphical format in which all variables but one are fixed. Such "parametric" equations help give insight into the conditions under which the correlations predict either high or low salvage. As an example, consider the following parametric curves in figure 1. These curves were generated using a Manly equation with a 12-day averaging period with prediction of salvage on the 12th day. The graph can be compared

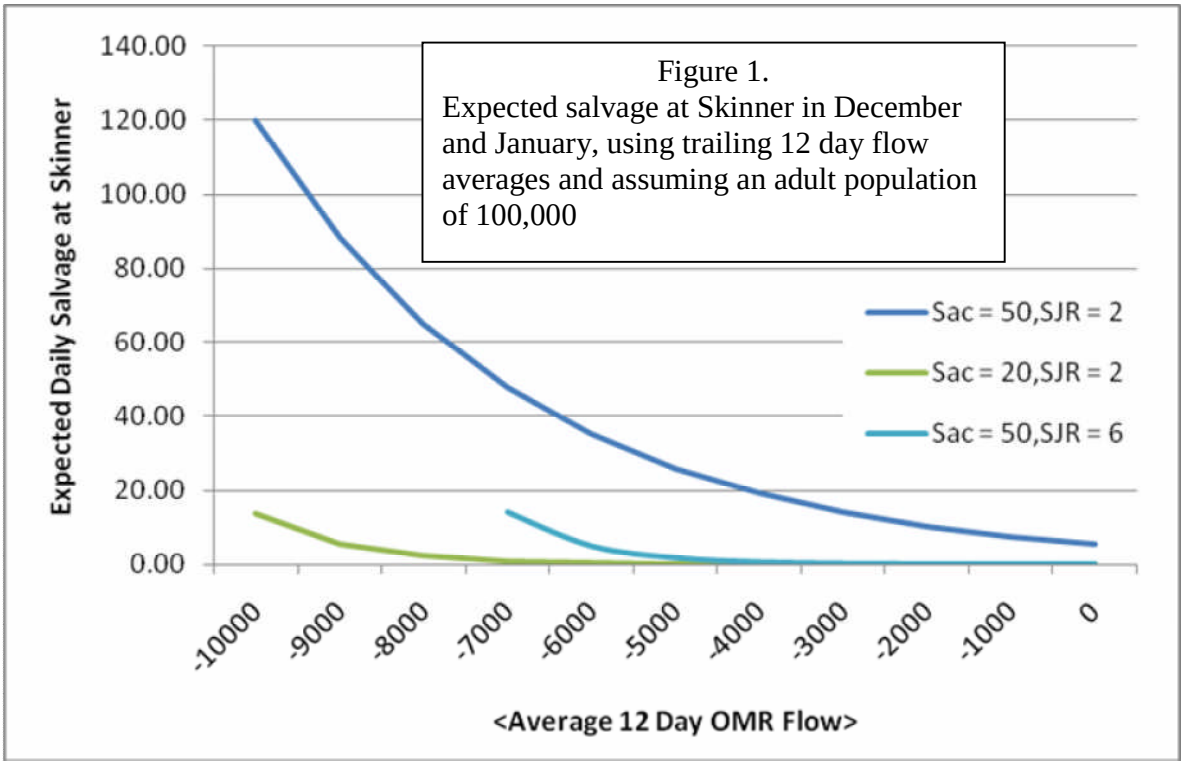


Figure 1.
Expected salvage at Skinner in December and January, using trailing 12 day flow averages and assuming an adult population of 100,000

to work by Pete Smith, Sheila Greene and others showing the relationship between Old and Middle River flows and salvage. But this graph is considerably more sophisticated:

- The curves show the exponential nature of the OMR/ salvage relationship as asserted by Greene and now supported by Smith. However, what the correlations indicate is that there are many exponential relationships – one for every combination of Sacramento and San Joaquin flow. Many of the exponential curves never grow much above zero, meaning that expected salvage is low, even with high reverse flows in Old and Middle River. Only very particular combinations of Sacramento and San Joaquin River flow would create a circumstance in which reverse flow less than -5,000 cfs would provide much benefit compared to -5,000 cfs.

- The salvage predictions are for a particular day, not a long term average. Thus, predicted salvage over the next week can be estimated each day in the winter. The graphs show that in order to reduce predicted salvage, all that need be done is to reduce OMR negative flows to a safe level. In general that level will be around -5000

cfs, although when the Sacramento River is running around 50,000 cfs, additional cuts might be desirable. By comparison, the flow limitations imposed by the federal court limit negative OMR flows to a *maximum* of 5,000 cfs and provide that they may be reduced to as little as -750 cfs. The Manly statistical analysis shows that such a limitation is unnecessary to minimize the take of smelt at the Project pumps.

Similarly, consider Figure 2. This is another set of parametric curves using the same Manly correlation. Now, however, Sacramento flows are allowed to vary. Again, the key observation from previous years – that there is little risk of salvage at Sacramento flows below about 25,000 cfs is borne out. This is true even when Old and Middle River flows are highly negative. However, as average Sacramento flow rises above 40,000 cfs, the correlation shows that Old and Middle River flows need to be scaled downward in order to reduce salvage to low levels.

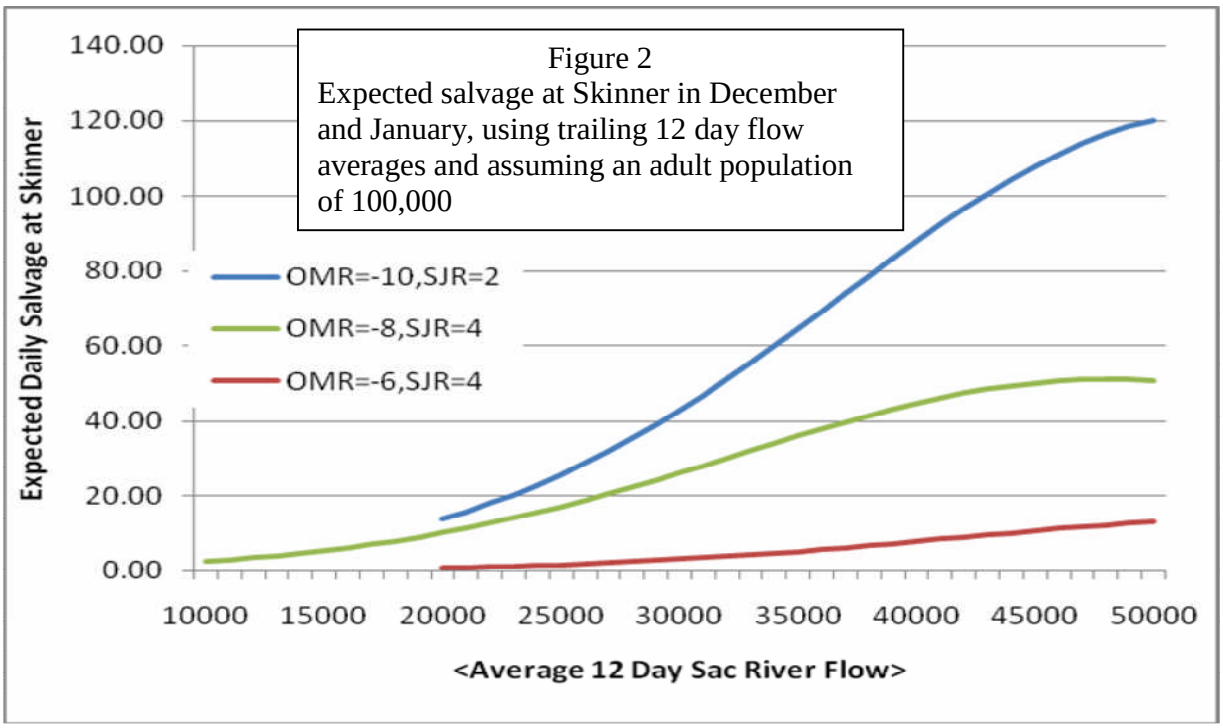


Figure 2
Expected salvage at Skinner in December and January, using trailing 12 day flow averages and assuming an adult population of 100,000

Based upon Dr. Manly's work, the State Water Contractors are increasingly confident that adult smelt salvage can be managed at relatively low water cost. Additional work is continuing to study the problem of juvenile smelt salvage. Our hope is that we can similarly operate around these problems as well.

The population effects of the flows analyzed by Dr. Manly can also be evaluated with a population model that incorporates the equations developed by Dr. Manly as a result of his evaluation of the relationship between Delta smelt salvage, abundance and flow. Dr. Manly evaluated associations of adult delta smelt salvage with abundance and flows during December-January and February-March at the Skinner and Tracy fish facilities. He also evaluated April-June entrainment risks for larval and juvenile delta smelt in terms of the percent of the

population occurring in the southeastern delta. His results are being used to quantify effects of exports and other variables in a delta smelt population model.

The Delta Smelt Entrainment model, or DSE, has been developed by Dr. Philip Unger and Dr. Richard Sitts to evaluate population effects of take at the SWP and CVP pumps. DSE is based on concepts in Dr. William Bennett's 2005 paper, "Critical Assessment of the Delta Smelt Population in the San Francisco Estuary, California," in San Francisco Estuary and Watershed Science. DSE development also included analyses of all four of the existing Delta smelt datasets. The evaluations of Drs, Unger and Sitts involved estimating Delta smelt abundances by mm length class by survey, and using these estimates to estimate survival rates from one life stage to the next for use in the model. The model provides predictions of the Delta smelt population effect of different levels of adult, larvae and juvenile delta smelt take at the pumps. Take estimates are specified or can be functions of various flow or pumping rates. The core of the model estimates abundances of the four successive life stages within a year, over one or more several years. DSE will be developed further based on ongoing evaluations.

The salvage and entrainment equations developed for the DSE by Dr. Manly allow prediction of Delta smelt losses at the pumps through the year as a function of Old and Middle River flows, Sacramento flows, San Joaquin flows, overall abundance, and other parameters. DSE adjusts predicted losses at the pumps by the survival rate for the specific life stage to account for those fish lost that would have been lost to the population anyway out in the Delta due to other factors. DSE takes the adjusted losses and subtracts them from the population at the time to determine the population level effect of the given flow regime. Thus, DSE can be used to define efficient operations that provide high levels of smelt protection at the lowest possible water costs, as well as to compare operations. For example, DSE has been used to compare historic losses given upper and lower Old and Middle rivers flow specified for winter/spring 2008.

WORKSHOP ISSUE NO. 6 – RECOMMENDATIONS FOR SHORT TERM AND LONG TERM ACTIONS BY THE STATE BOARD TO IMPROVE HABITAT CONDITIONS FOR PELAGIC SPECIES

The State Contractors expect that some of the parties to the Workshop will bring to the State Board new requests for regulation of the SWP and CVP beyond the limitations that already exist as a result of D-1641 and the recently adopted Remedial Order of the federal court. We expect, for example, that the State Board will hear statements concerning a proposal that an X-2 objective be established in the fall months on the theory that there is a correlation between fall outflows and the following year's Delta smelt abundance. We recommend, however, that the Board *not* attempt to deal with pelagic organism issues by requiring Delta outflow increases that attempt to position X-2 during the fall months. Such a proposal was the subject of considerable testimony during the trial in *NRDC v. Kempthorne* and was firmly rejected by the federal court.

There were several reasons for this outcome. The first was that the testimony established the Delta Smelt Working Group ("DSWG") had already considered, and rejected, a measure to control fall salinity that involved placement of X-2 in a similar manner. (Tr. 444:23-445:5;

1207:15-25; 1208-1-14).[5] The DSWG declined to do so because the increased outflow would not be enough to detectably change physical habitat quality or quantity; nor would it change overbite clam distribution. Tr. 1208:10-14. Second, the testimony presented to the federal court showed there is considerable disagreement among scientists about the benefits of such a measure for pelagic species. The testimony showed, for example, that *none* of the scientific articles or correlations advanced by proponents of a fall X-2 measure demonstrated a causal relationship between fall salinity and the following year's Delta smelt abundance. Tr. 952:18-21; 995:6-11. To the contrary, one of the articles presented to the Court for the purpose of attempting to support the measure actually demonstrated there is no statistically significant relationship between environmental quality and effects on Delta smelt of positioning X-2 near kilometer 80 (measured from the Golden Gate Bridge) as the plaintiffs in the litigation had proposed. Tr. 1011:1-4. The same article expressly *declined* to support the use of its analysis of X-2 for purposes of conducting management actions for the SWP and CVP. Tr. 952:22-24.

Similarly, a study created by Guerin of the Contra Costa Water District was offered during the trial by the advocates of a fall X-2 measure to show a correlation between fall salinity and smelt abundance the following year. However, the correlation was based on limited data generated over a limited number of years and, when data for more recent years was used, the correlation was no longer statistically significant. See Decl. of David Fullerton, SWC Exh. Q, in *NRDC v. Kempthorne*, pp. 4-7. (A copy of the Fullerton Declaration is attached as Exh. 7)[6].

Moreover, there is no evidence to suggest that reduced fall salinity "causes" reduced population abundance for the Delta smelt – or any other pelagic species. As explained by Fullerton, the correlations that have been offered by advocates of a fall X-2 measure depend upon few data points generated during the extended drought of 1987 to 1994 and a few data points with higher smelt populations generated during the extended wet period that occurred in the latter half of the 1990s. Exh. 6, pp. 9-10. Simply because extended droughts are bad for smelt (and, likely for other pelagic species) and extended wet periods are good for smelt, it does not follow that artificially boosting outflow for a few months in dry years – at enormous cost to other beneficial uses dependent upon scarce fresh water supplies – will reproduce the complex conditions necessary to generate the benefits associated with wet years.

---

[5] The reference provided are the citations to the page and line of the official hearing transcript of proceedings before the federal court in *NRDC v. Kempthorne*. Because of the size of the transcript, it is not attached hereto. Upon request, however, the transcript – or excerpts therefrom – will be provided.

[6] A second correlation, by Feyrer, was also offered, but served to explain very little of the variation in summer smelt population abundance. *Id.* Moreover, as explained in Exhibit 8 attached hereto, Feyrer's implicit assumption that recent higher fall salinities are primarily caused by increases in SWP and CVP exports, is inconsistent with the data. To the contrary, the data show that the predominant reason for a decline in Delta outflow is a reduction in Delta inflow, not an increase in Project exports. The data further show that a reduction in Sacramento Valley Accretions is the largest single factor accounting for a reduction in inflow, with the primary cause of the change attributable to reduced Sacramento Valley precipitation in more recent years, followed by lesser causes such as increases in irrigation use and changed water management practices for crop irrigation. *Id*. Other factors contributing to the decline in Delta inflow are reduced imports from the Trinity River attributable to increased downstream Trinity River flows and reduced variations in Feather River flow releases from Oroville Dam resulting from compliance with a 1983 DFG fish agreement adopted for the protection of salmon spawning downstream of the dam. *Id.*

Consistent with the foregoing conclusion, the USFWS testified during the trial that using outflow to position X-2 in the fall would not necessarily provide benefits, because the biology underlying the action is uncertain. Tr. 669:8-24. Among other things, habitat does not appear to be a limiting factor. Tr. 953:2-12. Further, because of the existing Delta outflow requirements already included in D-1641 for the protection of Delta municipal and agricultural uses, fall salinity in the location where X-2 was proposed to be positioned is expected to be about 3 to 4 ppt in any event – a level well within the tolerance of the Delta smelt. Tr. 1013:4-11. Finally, the volume of water required to move X-2 in the fall is so large that attempting to do so could deplete the cold water pools in upstream reservoirs that are needed to protect winter-run salmon, steelhead and other listed anadromous fish species. Tr. 669:18-24; 670:8-672:12; 1022:1-1024:19; 1486:19-1488:22; 1489:7-23; 1490:18-1492:16.

It thus was not surprising that the federal court rejected efforts to impose a fall X-2 measure on the SWP and CVP. According to the Court:

> Plaintiffs' proposed fall action to maintain Delta outflow at a minimum of 7,500 cfs or maintain X-2 as a fourteen day running average at downstream of 80 km, whichever requires less fresh water outflow was not support by a preponderance of evidence because: (1) not supported by peer-reviewed analysis; (2) the Delta Smelt Working Group declined to support similar actions put before them; and (3) there is material uncertainty among scientists about the benefit of this action for the Delta smelt in the fact of its requirement of a large commitment of water to uses in times of summer heat.
>
> The significant quality of water that would be required for proposed fall actions, approaching 500,000 acre feet ("A.F.") in an average water year, in light of the scientific dispute and other scientists' rejection of such a plan; the scientific uncertainty; and the low risk-reward benefit analysis does not justify imposition of a fall remedial measure.

Exhibit 2, pp. 21-22.

This conclusion is compatible with the report of the Suisun Ecological Workgroup previously presented to the State Board in November 2001. The Workgroup was convened by DWR at the direction of the State Board to evaluate the technical basis of the Suisun Marsh water quality objectives and their effects on beneficial uses. After finding that water quality issues in the Marsh were "inextricably connected" to the timing and volume of Delta outflows, the Workgroup reported the recommendations of its Aquatic Habitat Subcommittee. The Subcommittee's recommendations included the following:

> The subcommittee does not believe that current WQCP operations in the fall provide any particular benefit for native fish populations. In fact, there is information that suggests low salinities during the

> fall period may support the establishment of introduced fish species (Moyle and Herbold 1983; Moyle and Herbold 1986).

Suisun Workgroup Final Report, p. 3.

Thus, a fall X-2 measure is incompatible with the findings and Order of the federal court that dealt with this precise issue. It is also inconsistent with the Final Report of the Suisun Ecological Workgroup previously convened at the direction of the State Board. Together, the findings of the federal Court and the Final Report of the Suisun Workgroup show that a fall X-2 measure not only fails to produce a benefit for pelagic species; it will, instead, enhance the conditions for introduced species at the expense of native species.

While a fall X-2 measure has already been examined and rejected, there *is* a fall operational measure that warrants the Board's attention. Development in the early 1900s effectively eliminated more than 52,000 acres of brackish habitat in Suisun Marsh that once served as a valuable nursery area for juvenile smelt and other pelagic species. In earlier water quality control plans, the State Board established low salinity objectives in Suisun Marsh to support managed, diked wetlands. These objectives were established in furtherance of the now-discredited belief that depressed salinities in the Marsh are necessary for the production of sufficient food for migrating waterfowl. As the Final Report of the Suisun Ecological Workgroup states:

> Salinity standards for Suisun Marsh, adopted by SWRCB in 1978 in Decision 1485, were based principally on the Department of Fish and Game's (DFG) recommendations … DFG's recommendations to SWRCB were based principally on ecological studies conducted by Mall (1969) and Rollins (1973). These two studies examined: (1) the relative value of marsh plants as duck food; (2) the influence of soil salinity and other factors on distribution and growth of marsh plants; and (3) the relationships between channel water salinity and soil salinity….Results from the study by Mall (1969) identified alkali bulrush, brass buttons, fat hen, and cultivated barley as the foods eaten most frequently by migrating waterfowl. However, DFG recently noted that the methods used in this study, while state of the art at the time, may not accurately reflect which foods are most frequently consumed by waterfowl.

Suisun Workgroup Final Report, p. 10.

Indeed, the Suisun Workgroup found that the plant species used by waterfowl as food are found "in abundance" in tidal and diked wetlands in "other" parts of the estuary (Final Report, p. 28) and that the artificial reduction of channel water salinity through operation of the SMSCG actually causes some plant species – including rare and endangered native plants – to progressively decline. *Id*., p. 37. Thus, not only have 52,000 acres of potential pelagic species nursery been lost, they have been lost in pursuit of a DFG theory of waterfowl food abundance

that is based upon an inaccurate assessment of the foods consumed by waterfowl and whose implementation is resulting in the destruction of rare and endangered native plant species.

The artificially low Suisun Marsh salinity objectives, particularly in the fall, are now met in large part through operation of the Suisun Marsh Salinity Control Gates ("SMSCG"). The Salinity Control Gates function by tidally diverting fresher flows from the Sacramento River at Collinsville into Montezuma Slough while blocking tidal return flows from the Slough. While operation of the SMSCG does reduce salinity in Suisun Marsh for the benefit of plant production for waterfowl, the operation may also have adverse impacts to pelagic species. Flows in the main channel of the Sacramento River downstream of Collinsville are reduced, resulting in higher salinities from Port Chicago to Emmaton and Jersey Point. The increase can be as much as 2,000 umhos/cm. electro conductivity. Operation of the salinity gates can also divert smelt and other pelagic species from the Sacramento River into Montezuma Slough, where they can be prevented from later upstream migration for spawning, due to continued operation of the gates. The salinity gates also cut off the tidal exchange of nutrients and organisms between Suisun Bay and its marsh. Thus, reconsideration of the need for the Suisun Marsh salinity objectives and modification of the Suisun Marsh gate operations represents an important "knob" that the State Board may consider turning for the benefit of pelagic species.

The State Board did not implement the recommendations of the Suisun Ecological Workgroup in its 2006 Water Quality Control Plan; however, it did provide for conditional implementation of water quality objectives at Stations S-97 and S-35. The 2006 WQCP also deferred further consideration of the Suisun Marsh standards pending development of a programmatic EIR/EIS for the Habitat Management, Preservation and Restoration Plan for Suisun Marsh (Suisun Plan). Before committing already scarce SWP and CVP water supplies to the support of yet another faulty theory involving the fall positioning of X-2, the State Contractors suggest it would be of more value to pelagic species to investigate the value of continuing to pursue the isolation of more than 52,000 acres of once brackish Suisun Marsh aquatic habitat. Accordingly, given the potential for adverse impacts to pelagic species from continued operations to meet Suisun Marsh water quality objectives, the State Contractors believe the Board should engage early in the development of the Suisun Plan. We also recommend the Board hold a workshop in the first half of 2008 on the impacts of the Suisun Marsh Salinity Control Gate operation on pelagic fishes and the direction being taken in the development of the Suisun Plan.

CONCLUSION

Because vast resources are needed to effectively evaluate and regulate the multiple causes of the pelagic species decline, the State Board must be selective in its approach to the issue. Furthermore, because the State Water Project and Central Valley Project are already subject to intense regulatory scrutiny and control through Water Right Decision 1641 and the Interim Remedial Order recently issued by the federal district court in *NRDC v. Kempthorne*, it does not make much sense to attempt to impose even more controls upon the Projects that serve as the source of water supply for the large majority of California's population. Doing so would simply invite inconsistency with the administrative and judicial measures that have already been imposed on the SWP and CVP by this Board and the courts.

However, given the regulatory imbalance that currently exists, there is much the Board can – and should – do to evaluate and, where appropriate, assert control over the *other* factors that are contributing to the decline of pelagic species but have escaped regulatory consideration. Thus, while the State Board *should* continue to closely monitor ongoing Project-related efforts such as the ESA reconsultations and the BDCP process, both of which are now underway and are focusing upon near and long-term changes in the operations of the SWP and CVP, it is *also* important that the Board focus its administrative efforts on in-Delta toxic discharges, the other 2,000 in-Delta diversions (many of which are unscreened), the operations of the Suisun Marsh Control gates, predatory non-native species such as striped, small-mouth, and large-mouth bass, and similar topics that have been too long ignored. More specifically, the State Contractors recommend the Board undertake the following on a high priority basis:

1. Compilation and assessment of available data on contaminants and toxicity to determine the extent to which contaminants are contributing to the POD;

2. Development and implementation of a Delta-wide toxicity monitoring program to provide data on the character and sources of contaminants in Delta sediments, water and aquatic organisms;

3. An investigation of (1) the link between sediment contamination and possible effects on pelagic organisms either through food web transfers or through re-suspension of sediments during storm or wind events, (2) the effects of metals and other contaminants on the olfactory response of Delta pelagic species, and (3) the concentrations of endocrine disrupting chemicals in the Delta as well as of the impacts of these chemicals on pelagic species;

4. Development and implementation of a program of monitoring pollutant discharges from Delta islands;

5. Immediately require wastewater treatment plants in or upstream of the Delta seeking to increase their treatment capacities, to evaluate the effect of their expansion on pelagic species;

6. Initiation of screening studies of the potential inhibition of primary productivity and toxicity to fish associated with ammonia concentrations in the Delta and the sources of such discharges and implement appropriate controls to protect fishery beneficial uses;

7. Development and implementation of a standardized monitoring program to better understand blue-green algal blooms;

8. Initiation of a State Board proceeding to evaluate and mitigate the impact of in-Delta municipal, industrial and agricultural diversions that are not already subject to the terms of Water Right Decision 1641;

9. Initiation and pursuit of discussions with the Department of Fish and Game to integrate or add to their normal monitoring activities, sensitive and statistically valid fishery survey protocols that are relevant to pelagic species and more accurately reflect the distribution and abundance of such species in a statistically valid manner;

10. Scheduling of a workshop within the next three months to receive updated information on: (1) the impacts of Montezuma Slough Salinity Control Gate operations on the POD and (2) an update of the Suisun Marsh Habitat Management Preservation and Restoration Program, including what measures the program includes to address the need for existing water quality objectives and the POD impacts of those objectives;

11. Scheduling of a workshop within the next three months to evaluate programs conducted by the Department of Fish and Game to protect and promote non-native, predatory species such as striped bass and small mouth and large mouth bass, including a determination of the extent to which those programs are a threat to listed species, whether they contribute to the POD and whether they are compatible with the requirements of the public trust;

12. Development and implementation of regulatory controls, in coordination with the SLC and USEPA, to address the introduction of invasive species from ballast water discharges;

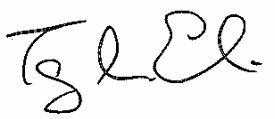
13. Increase State Board monitoring of the Bay-Delta Conservation Plan process, including attendance at technical meetings relating to proposals to improve environmental conditions for POD species.

14. Scheduling of a workshop within the next six months to receive information regarding the Delta Vision process and the Bay-Delta Conservation Plan. Such a workshop will provide the Board with information on the process being pursued to develop the BDCP, its regulatory framework, the schedule for its development and implementation and the likely interaction of the BDCP with State Board processes.

15. Scheduling of a workshop for the latter half of 2008 to receive a status report regarding development by the United States Fish and Wildlife Service of the Biological Opinion for the revised Operations Criteria and Plan for operation of the Central Valley Project and State Water Project, including the measures being considered by the USFWS for protection of endangered and threatened species. The workshop should include a review of the different approaches being advocated to manage water project entrainment of pelagic species, including the emerging correlations developed by Dr. Bryan Manly;

16. We also recommend that the State Board *not* attempt to deal with pelagic organism issues by requiring Delta outflow increases that seek to position X-2 during the fall months.

Respectfully submitted,



Terry L. Erlewine
General Manager
STATE WATER CONTRACTORS

Enclosures