Flow and Export Limitation Standards

Testimony for CA State Water Resources Control Board Workshop:
Comprehensive (Phase 2) Review and Update to Bay-Delta Plan
Workshop 1: Ecosystem Changes and the Low Salinity Zone
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Relevant Background and Experience: I am an estuarine fisheries ecologist and have been involved in Delta fishery issues for more than 35 years. I began my study of striped bass in estuaries as the statistician and technical director of the Hudson River Estuary Ecological Studies from 1972-1977. I have been involved in the Bay-Delta from 1977 to the present. During my years on the Hudson River, I consulted on several occasions with CDFG scientists working on striped bass in the Bay-Delta. Pete Chadwick, DFG's lead Delta scientist, was a consultant to the Hudson River program. From 1977-1980 I was project director of Bay-Delta ecological studies for PG&E's Bay-Delta power plants impact programs. From 1980-82, I was a consultant to the State Water Contractors, the National Marine Fisheries Service, the Electric Power Research Institute (ERPI), and State Water Resources Control Board focusing on evaluating the effectiveness of the D-1485 Bay-Delta Water Quality Standards in protecting the Bay-Delta ecosystem and the striped bass population. From 1986-1987 I was a consultant to the State Water Contractors and US Bureau of Reclamation during the SWRCB hearings on water quality standards. From 1994-1995, I was a consultant to the State Water Contractors and the California Urban Water Agencies, working on the 1995 Bay-Delta Water Quality Standards and how the new standards would affect the Bay-Delta ecosystem and striped bass population (and water supplies). From 1995-2003, I was a consultant to the CALFED Bay-Delta Program where I worked on various projects including the Ecosystem Restoration Program Plan (ERPP), the Delta Entrainment Effects Team (DEFT), the Tracy Technical Advisory Team (TTAT), the Environmental Water Account (EWA), and the Delta Cross Channel – Through Delta Facility (DCCTDF) evaluation team, where again potential effects on the fish populations and the ecosystem were subjects of interest. I prepared a comprehensive review of impacts from the south Delta pumping plants, the uses and benefits of an Environmental Water Account, and the potential effects from a Through Delta Facility. I also participated in project planning and development of the Delta Wetlands Project, the Montezuma Wetlands Project, and many other Bay-Delta development and restoration projects. In 2002 I participated in a DFG review of the status of the striped bass population. From 2002 to 2005, I was involved in activities related to the Striped Bass Stamp Program including stocking and tagging striped bass, continuing coordination with DFG on Delta issues, and as CSBA's representative on the DFG/DWR Four Pumps Mitigation Committee. More recently I have advised California Striped Bass Association on proposed new striped bass fishing regulations, and advised USBR staff on the merits of proposed new Fall X2 Standards. From 2005 through 2010 I undertook several new estuary habitat restoration projects in the Sacramento River, Yolo Bypass, and Suisun Bay.

I am very familiar with how the state and federal projects operate and how water project operators game the system to their advantage.

Summary and Conclusions

The 1978 Standards had numerous flaws but the major one was monthly average criteria. This flaw was addressed with the 1995 Standards. Unfortunately, the 1995 Standards had two major flaws – almost no export restrictions and new export/inflow ratio criteria. Revised standards that incorporate some of the recommendations of the Draft 1982 Two Agency Agreement and the Draft 1993 (D1630) Standards would significantly eliminate many of the Delta's ongoing problems. These essentially involve reducing exports and increasing outflow, but they are well within the findings and recommendations of the Board's own 2010 Delta Flow Report. The key solutions involve (1) not exporting the Low Salinity Zone at any time of the year, (2) keeping it as far down in the Bay as long as possible, (3) minimizing movement of the LSZ into the Central and South Delta, (4) focusing on natural flow regimes and salt movements by not causing dramatic one-day shifts because of Standards, and (5) limiting high inflows of reservoir water just to maximize exports and meet E/I standards. The history of fisheries decline in the Delta is a history of inadequate and non-protective Standards and a refusal to subsequently apply the knowledge learned from previous failures.

My focus is on the Low Salinity Zone because it is so important to the estuary ecosystem and production of all the major fish species including all the ESA listed species. Any new adopted Standards should focus on maintaining the health of this critical zone of the estuary.

Introduction

The 1978 and 1995 Delta Standards brought about classic adaptive management experiments in the Delta, essentially one for each year in which the standards were employed. These experiments along with many years of monitoring, research, and analyses brought volumes of technical documents and testimony, restoration programs, and biological opinions. So when the State Board asked for input on what is new or what have has been learned since 2010 that might have a bearing on revising the 2006 Standards, it seemed appropriate to identify the problems and solutions once again.

Basically, we learned a lot over the 34 years since 1978, but along the way the lessons were ignored at least when it comes to adopting standards. So what is new? Well there are a few more years of experiments under the 95-06 standards. However, the 95 (and 06) Standards ignore most of the knowledge gained from past experiments and continue to cause declines in the valued fish populations that depend on the Delta. With each year of new "experiments" we see the consequences of the underlying problems with the old standards, yet we ignore obvious long-proposed solutions.

The first adaptive management experiments involved the early use of the State Delta Pumps in the South Delta during the period of 1969-1977. Massive numbers of fish were sacrificed to find out how the new pumps and Delta flows should be managed. The 1978 Standards (D-1485) were the consequences of that learning. These Standards provided considerable protection in terms of flow and export criteria and helped ameliorate the Delta fish facility massacres of the early 70s and the effects of the 76-77 drought.

The 1978 Standards were designed to protect striped bass and salmon, as well as other fish and the major elements of the Delta food chain. During the first several years of that "experiment" it was obvious to everyone that the standards helped in some respects, but "gaming of the system" by water project operators caused major problems. I managed two years of comprehensive Delta surveys in 78-79 to determine how the Delta power plants might fit into the new Standards. I oversaw a comprehensive review of the data to determine the very specific day-to-day, week-to-week, and month-to-month effects of the Standards in those two years. I wrote reports and communicated my findings in a variety of forums. The State Board assembled a group of experts in 1982 to provide advice as to why the 1978 Standards were not meeting their objectives. I was a part of this group, chaired by Don Kelly, retired DFG Delta biologist. Our group prepared a report and submitted it to the Board. DFG and DWR in conducted their own review and drafted a new Two-Agency Agreement as to how to operate the State Water Project and how to revise the 78 Standards. I also advised the State Water Contractors and NMFS at that time as to what was wrong with the Standards, how they could be fixed, and what I thought about the Draft 1982 Two Agency Agreement.

It was obvious to all these reviews that the 78 Standards needed to be revised very much along the lines of the Draft 1982 Two Agency Agreement. The basic problem was the monthly standards. The 1982 Draft Two Agency Agreement documented the problem and prescribed solutions. The goals included maintaining fish populations at average 1970-1981 levels until the goal could be raised to historical levels. The changes recommended included weekly or 14-day running averages for many of the monthly standards, substantial modification of export levels and recognition that "some reservation of presently unregulated flows may be necessary to accomplish the goals of this Agreement. Such reservations could be accomplished either by increasing minimum outflows or by limited future exports and diversions to storage." The parties believed that the 78 Standards with the added protections provided by the Two Agency Agreement would protect striped bass and other estuary fish at the 1980's export level of 4.5 MAF. The final EIR for the proposed Two Agency Agreement stated that the proposed agreement would provide greater protections than the 78 Standards but that any increase in exports beyond the current level would cause further impacts. Indeed, the EIR concluded that expansion of the SWP Banks Pumping Plant (four new pumps) would create additional adverse impacts. Consequently, the Two Agency Agreement stated that expansion, beyond the existing US Army Corps of Engineers constraints that allowed some higher winter exports, would only occur if <u>(1) the parties agreed upon additional operational constraints;</u> **and** <u>(2) fish screens at the SWP fish facility were upgraded.</u> It should be noted that NMFS had commented on an earlier draft of the Two Agency

Agreement that existing exports of 3 MAF had caused adverse impacts and plans to export 4.3 MAF posed the greatest of threats to remaining resources.

Unfortunately, the water contractors refused to agree to the recommendations despite the DWR, DFG, FWS, NMFS, USBR, and State Board staff all endorsing them. More hearings, much analysis and testimony, and more years of "experiments" followed. An attempt was made to formally revise the standards again in 1986-88. But, because of strong opposition by water contractors, no changes were made.

The arguments and "experiments" continued until new draft standards were proposed in the Draft D-1630 Standards in 1993. These too were not adopted. More intensive negotiations followed leading to new 1995 Standards and the eventual adoption of D-1641. These Standards are the basic standards we have today. The 1995 Standards have two major flaws – summer export restrictions in the 78 Standards were removed and export/inflow ratio criteria were added. The resulting higher summer exports (11,500 cfs versus 6,000-7,600 cfs) have been devastating to the LSZ, the Bay-Delta ecosystem, and the populations of many native and valuable sport fishes.

The conflict over the adequacy of the Standards continued in the CALFED process and then again in hearings and workshops for the 2006 Standards. The drought of 07-09 exacerbated conditions and the Standards did not provide protection - fish populations crashed. Efforts in the past few years to find the "cause" and the "solution" within the BDCP process have not resolved the age-old issues. The BDCP program now proposes to proceed with constructing massive new Delta infrastructure that will fundamentally alter the hydrology of the estuary while we spend many more years figuring out how to best operate the new system under export demands of 6-8 million acre-ft. This language is reminiscent of the rhetoric from the 1960s and 1970s when the State Water Project was coming on line, and fish populations were crashing under exports of 3-4 million acre-ft.

I now address several specific problems with the 1978 and 1995 Standards and their effects on the LSZ and then compare events of 2011-12 with 2002. Mistakes of the past, if left uncorrected, have a habit of reoccurring.

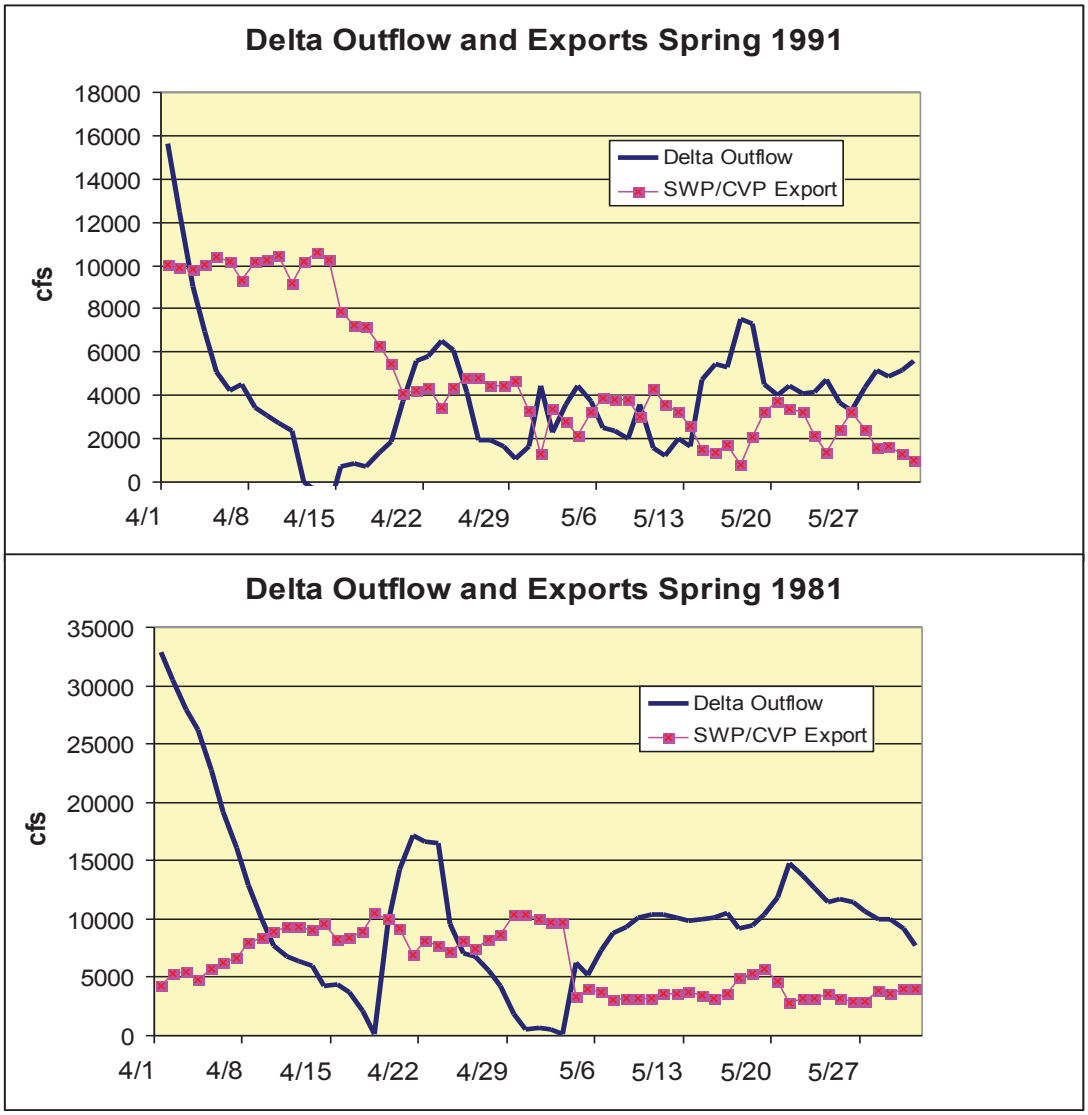
1978 Standards (D-1485)

The 78 monthly Delta outflow standards were 6700 cfs for early April, and 3,000 to 14,000 cfs for May through July depending on year type (see table below). Exports restrictions were 6,000 cfs in May and June, and 7,600 cfs in July.

Table III-1. Water Right Decision 1485 (D-1485) water quality standards for the Sacramento-San Joaquin Delta and Suisun Marsh[1/] (continued).

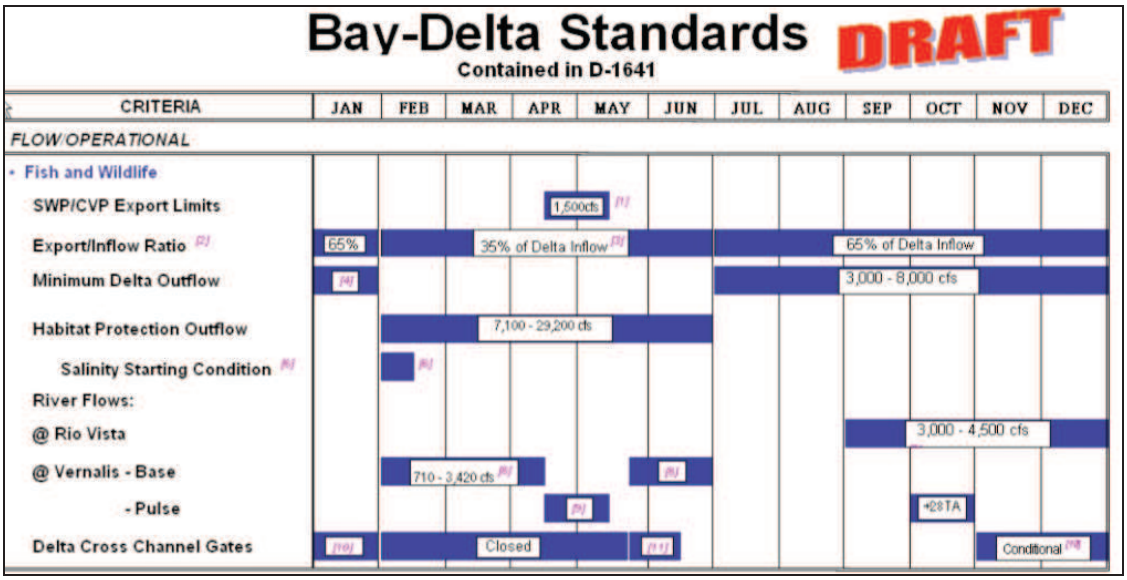
BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE[2/]	VALUES
FISH AND WILDLIFE				
• *STRIPED BASS SPAWNING*				
Prisoners Point on the San Joaquin River	*Electrical Conductivity*	*Average of mean daily EC for the period not to exceed*	*All*	*April 1 to May 5* — *0.550 mmhos*
Chipps Island	*Delta Outflow Index in cfs*	*Average of the daily Delta outflow index for the period, not less than*	*All*	*April 1 to April 14* — *6700 cfs*
Antioch Waterworks Intake on the San Joaquin River	*Electrical Conductivity*	*Average of mean daily EC for the period, not more than*	*All*	*April 15 to May 5* — *1.5 mmhos*
Antioch Waterworks Intake	*Electrical Conductivity (Relaxation Provision — replaces the above Antioch and Chipps Island Standard whenever the projects impose deficiencies in firm supplies 5/*	*Average of mean daily EC for the period, not more than the values corresponding to the deficiencies taken (linear interpolation to be used to determine values between those shown)*	*All — whenever the projects impose deficiencies in firm supplies 5/*	*Total Annual Imposed Deficiency MAF* / *April 1 to May 5 EC in mmhos*: 0 — 1.5; 0.5 — 1.9; 1.0 — 2.5; 1.5 — 3.4; 2.0 — 4.4; 3.0 — 10.3; 4.0 or more — 25.2
• *STRIPED BASS SURVIVAL*				
Chipps Island	*Delta Outflow Index in cfs*	*Average of the daily Delta outflow index for each period shown not less than*	*Wet*	*May 6–31*: 14,000; *June*: 14,000; *July*: 10,000
			Ab. Normal	14,000; 10,700; 7,700
			Bl. Normal	11,400; 9,500; 6,500
			Subnormal Snowmelt	6,500; 5,400; 3,600
			Dry 6/	4,300; 3,600; 3,200
			Dry 7/ or Critical	3,300; 3,100; 2,900
• *SALMON MIGRATIONS*				
Rio Vista on the Sacramento River	*Computed net stream flow in cfs*	*Minimum 30-day running average of mean daily net flow*	*Wet*	*Jan.*: 2,500; *Feb. 1–Mar. 15*: 3,000; *Mar. 16–June 30*: 5,000
			Ab. Normal	2,500; 2,000; 3,000
			Bl. Normal	2,500; 2,000; 3,000
			Dry or Critical	1,500; 1,000; 2,000
			Wet	*July*: 3,000; *Aug.*: 1,000; *Sept. 1–Dec. 31*: 5,000
			Ab. Normal	2,000; 1,000; 2,500
			Bl. Normal	2,000; 1,000; 2,500
			Dry or Critical	1,000; 1,000; 1,500
• *OPERATIONAL CONSTRAINTS*				
Minimize diversion of young striped bass from the Delta	*Diversions in cfs*	*The mean monthly diversions from the Delta by the State Water Project (Department) not to exceed the values shown.*	*All*	*May*: 3,000; *June*: 3,000; *July*: 4,600
		The mean monthly diversions from the Delta by the Central Valley Project (Bureau), not to exceed the values shown	*All*	*May*: 3,000; *June*: 3,000
Minimize diversion of young striped bass into Central Delta		*Closure of Delta cross channel gates for up to 20 days but no more than two out of four consecutive days at the discretion of the Department of Fish and Game upon 12 hours notice*	*All — whenever the daily Delta outflow index is greater than 12,000 cfs*	*April 16–May 31*
Minimize cross Delta movement of Salmon		*Closure of Delta Cross Channel gates (whenever the daily Delta outflow index is greater than 12,000 cfs)*	*All*	*Jan. 1–April 15*

The problem with the 1978 Standards was that they were monthly average and thus subject to within month gaming by water project operators. As seen in the figure below, a monthly average is not very representative of what can really happen over a month. There were also no limits on April exports.

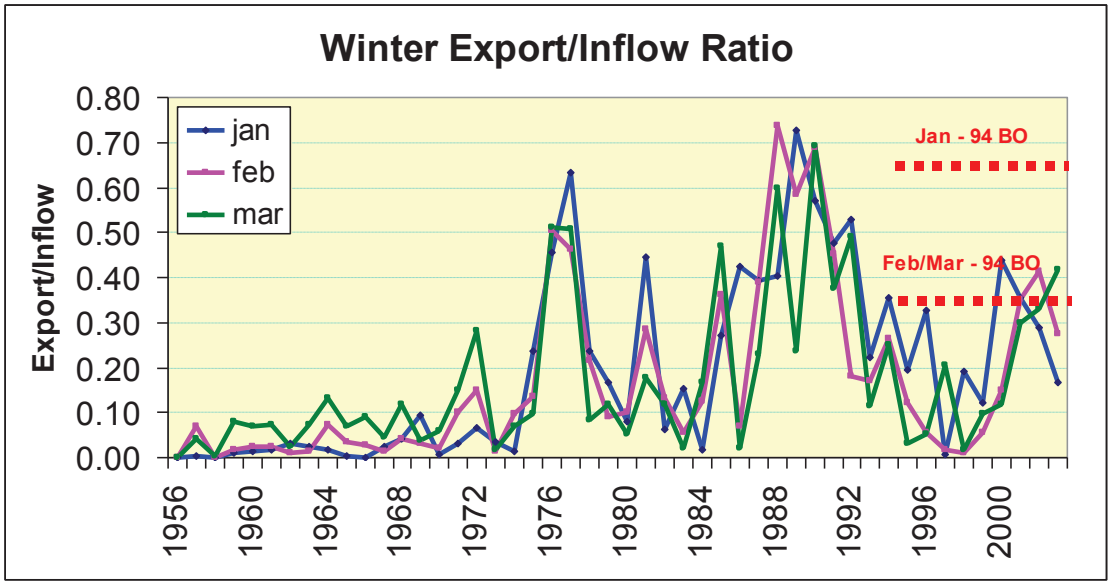


1995 Standards (D-1641) and Newer Constraints

The 1995 Standards alleviated the monthly average problem but replaced export limits with Export to Inflow ratio limits. An export limit of 1500 cfs was added for the "VAMP" period from April 15 to May 15. Minimum Delta outflows were set at 3,000 to 8,000 cfs, varying with month and year type.



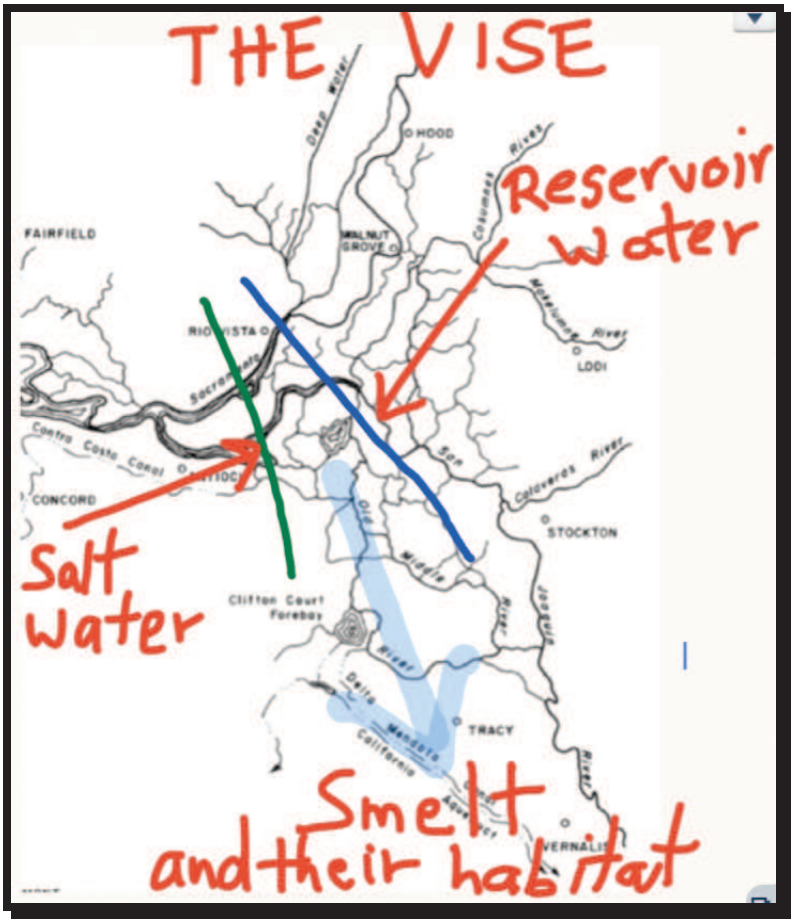
Some of the Biological Opinions in the last decade also added some restrictions on flow and exports. For example see the figure below showing the restrictions on the E/I in winter. High winter E/I ratios during droughts are a concern to all the species, because they lead to high salvage rates of older fish including delta smelt adult spawners as well as winter run Chinook smolts and spring run Chinook fry.



The major problem with the E/I Standard is that it allows exports up to the maximum of 11,500 cfs as long as there is sufficient inflow to maintain the target ratio limit. The standard results in maintaining relatively low May through June exports, as the ratio is 35% for these months. But in July, with a ratio of 65%, exports could easily be raised to the maximum, and often have been, and rather abruptly usually on July 1.

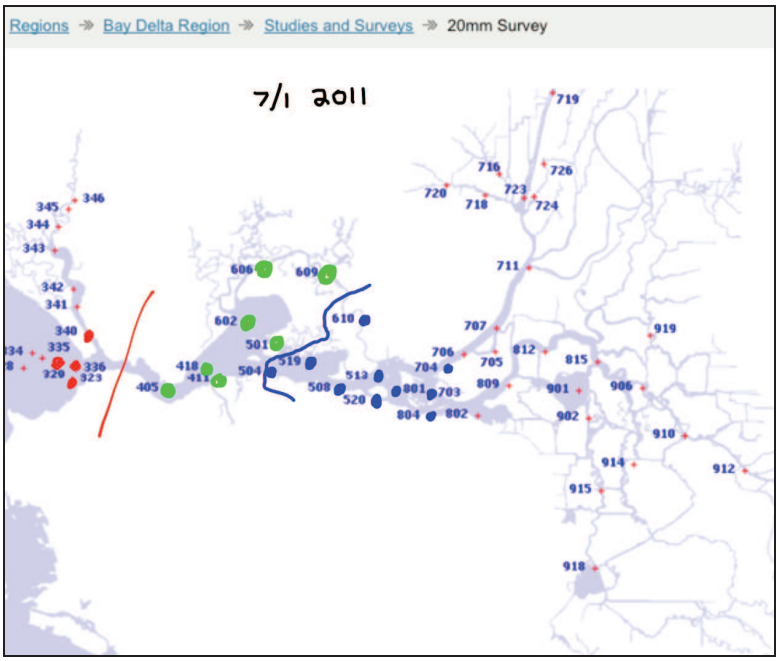
The consequence of the E/I Standards is what I term the "Vise" ("tooth past tube" is another good analogy) (see figure below). The LSZ is caught in the vise or tube and is slowly squeezed by the encroaching salt water and reservoir water inflows. The combination of high inflows and high exports actually pushes and pulls, respectively, the LSZ habitat into the Central and South Delta, and eventually out the pumping plants. The process leaves behind only a small remnant of the LSZ habitat so critical to all the POD species. Historically, this may have occurred in April-May prior to and after 1978 (D1485). After 1995 (D1641), this phenomenon was more likely to occur in July with the sharp shift in the E/I Ratio and the high export rates.

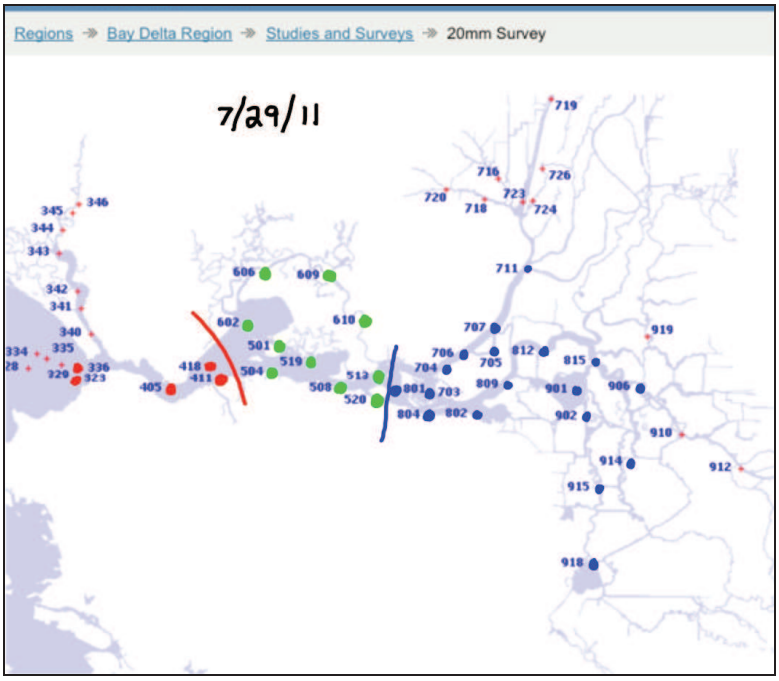
Some example years follow. These are only a few of the stories available.



Year 2011

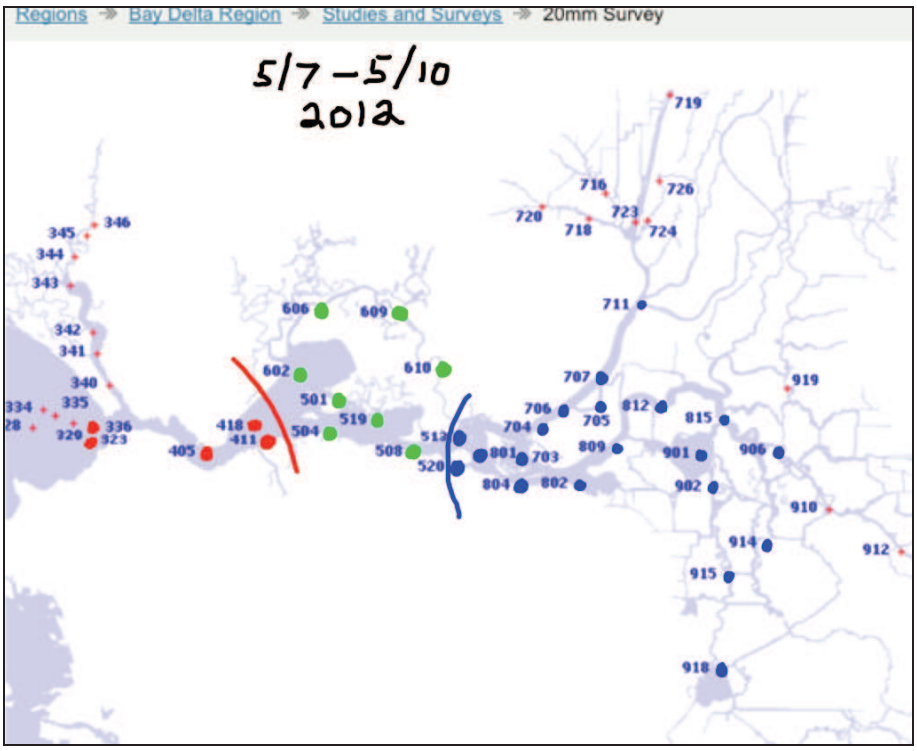
In 2011 early July inflows were 30,000 to 50,000 cfs, thus keeping the LSZ (green dots) far into Suisun Bay. Despite maximum exports the entire month, there was only a small movement of salt (red dots) toward the Delta in late July when outflow fell to 8,000 cfs. Needless to say, these conditions led to a 10-year high in the smelt fall index. I will discuss these events more in the next workshop.

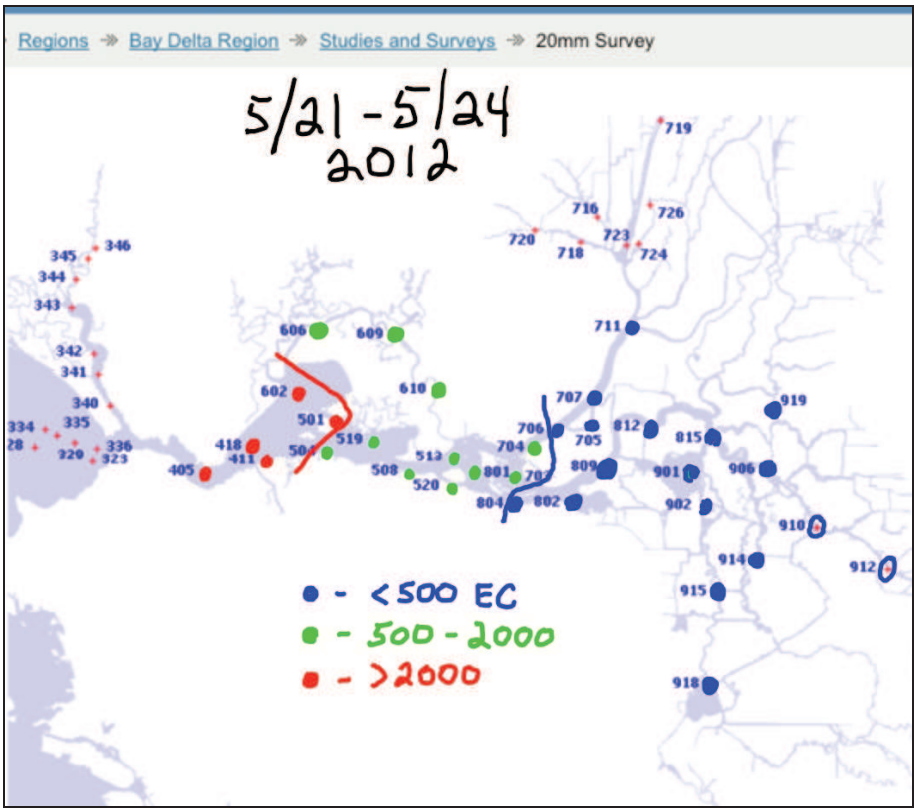




Year 2012

This year, 2012, started well for smelt (as can be seen in the 20-mm Survey data) with the LSZ located in Suisun Bay in May (see figures below with 20-MM Survey EC data). During May Delta outflow dropped from 28,000 to 13,000 cfs, exports rose from 2,000 to 5,000 cfs and E/I rose from 6% to 33%. Delta inflow dropped from 32,000 to 14,000 cfs. In June Delta inflow gradually rose from 14,000 to 22,000 cfs, while exports gradually rose to 6,000 cfs. By early June the Vise was strong with much of the LSZ confined in a small area of the lower Western Delta. (Early indication for the Smelt Summer Index from a survey in early June is that the index will be much lower than expected given the high index last fall. July survey data is not yet available.) The Vise slackened in mid June with higher outflows, only to press again at the beginning of July. In July, Delta inflow rose to 25,000 cfs as exports rose to 9,500-11,500 cfs range.

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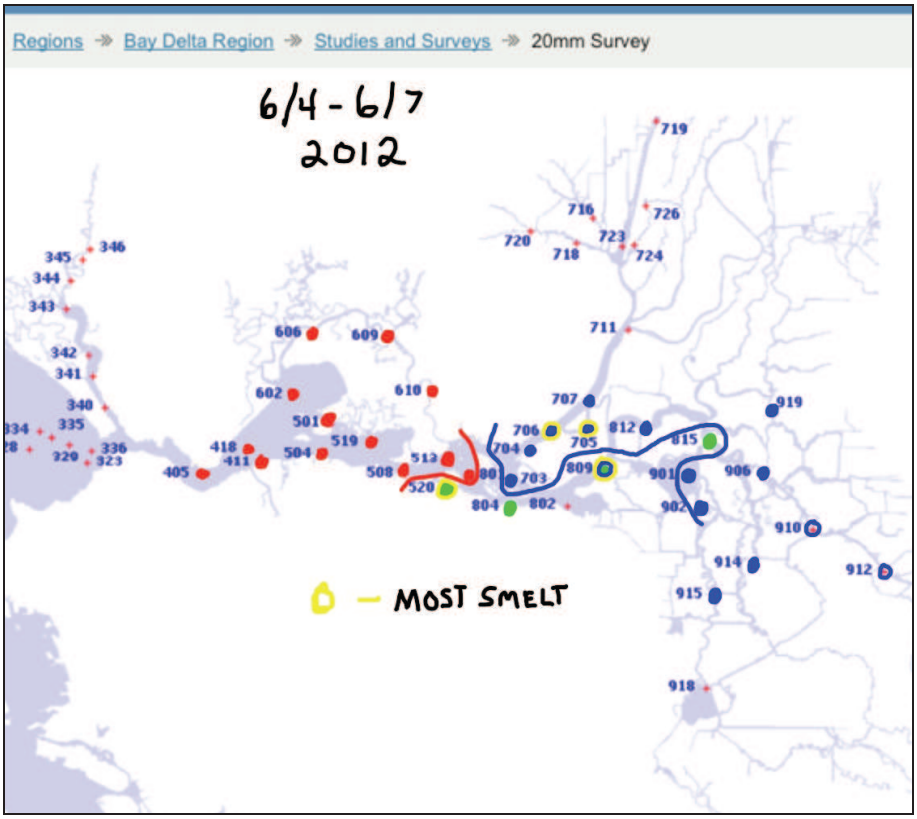
5/21 - 5/24
2012
- <500 EC
- 500 - 2000
- >2000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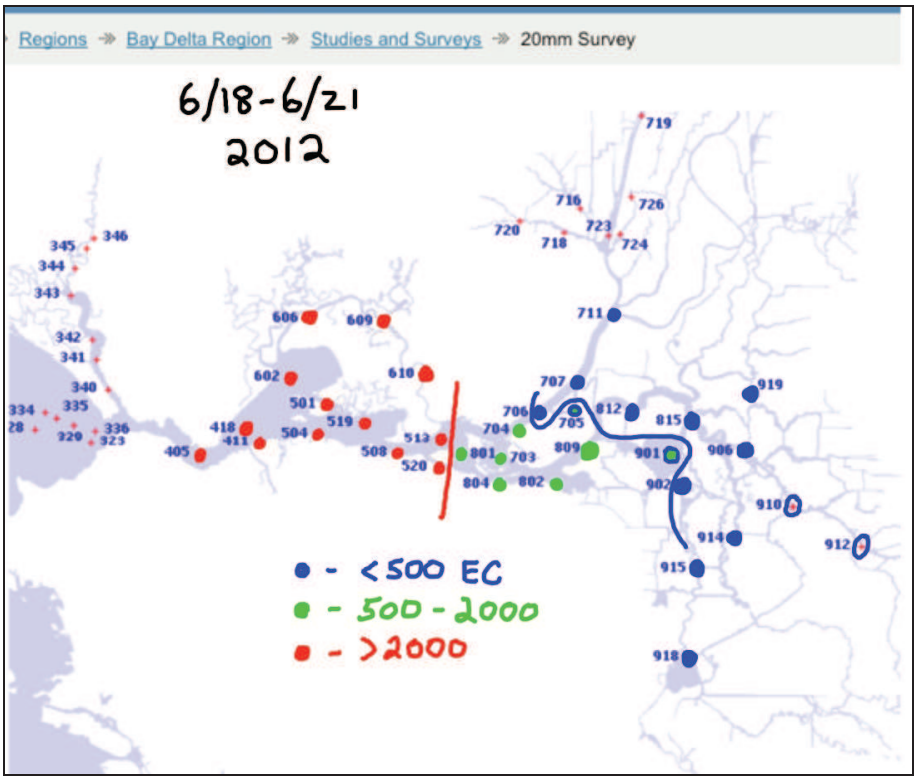
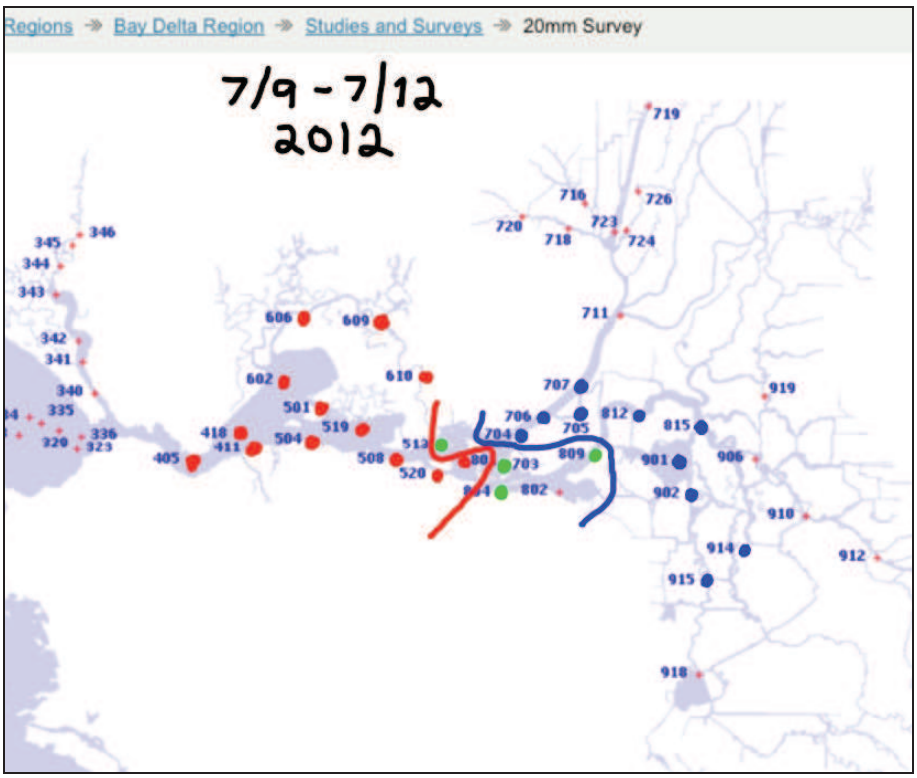
6/4 - 6/7
2012
— MOST SMELT


Regions » Bay Delta Region » Studies and Surveys » 20mm Survey
6/18-6/21
2012
• - <500 EC
• - 500-2000
• - >2000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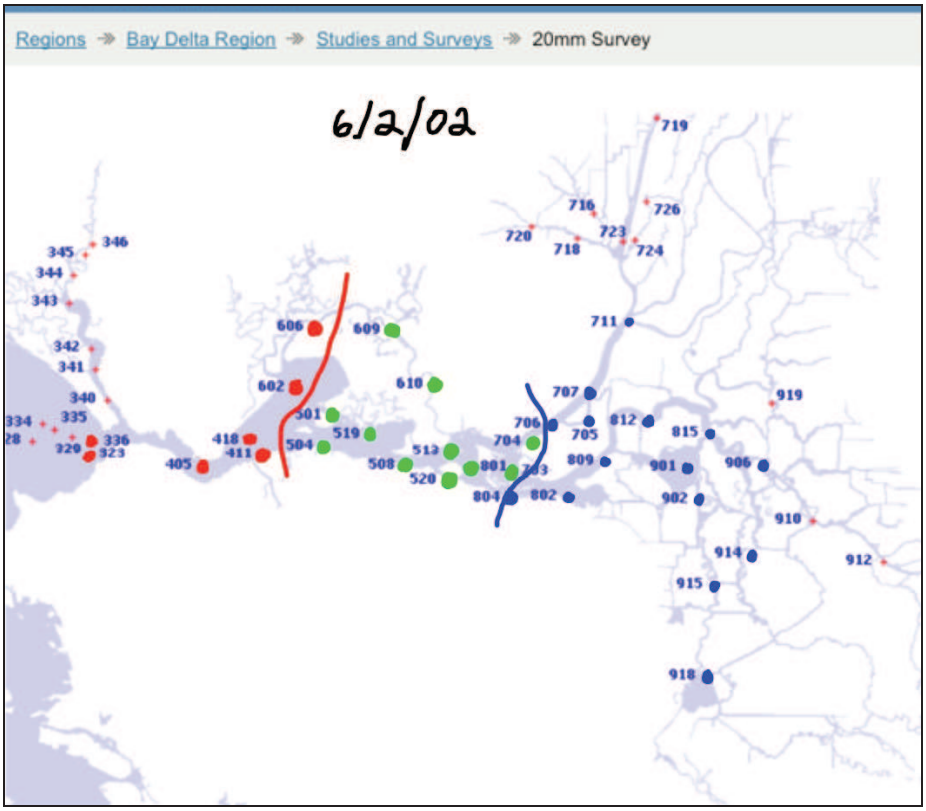
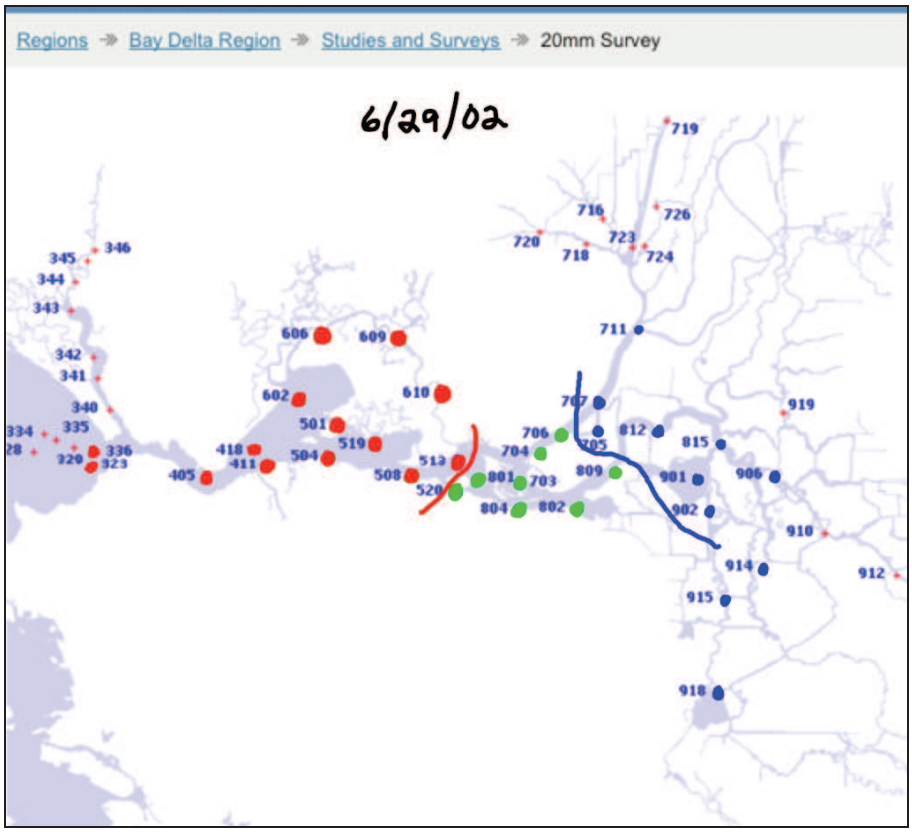
7/9-7/12
2012

Year 2002

In contrast to 2011 but similar to 2012, June 2002 saw the LSZ move upstream into the western Delta during June under moderate exports, and then move more sharply in July as the Vise grip strengthened. The movement was gradual during June as exports rose from 2,000 to 6,000 cfs, inflow rose from 15,000 to 19,000 cfs, and outflow was low and steady at 6,000-7,000 cfs. On July 1 exports rose immediately above 10,000 cfs and reached 11,500 cfs in the last ten days of the month. Delta inflow rose to 22,000 cfs, while outflow fell into the 4,000-6,000 cfs range.

It is this sharp change at the end of June that suddenly drives the LSZ into the western Delta out of eastern Suisun Bay. In the next workshop I will show that this is probably the primary cause of many of the sudden drops in the smelt fall index as in 2002, the year that marked the beginning of the POD. The culprits here are the sudden change, the low outflow, high inflow, and very high exports – the Vise. Under D-1485 the July export limit would have been 7,600 cfs.





Another example from 2002 that helps describe the negative consequences of the E/I standards is shown in the next figure for January 2002. Here the closure of the Delta Cross Channel (DCC) during high export periods brought about dramatic changes to Central Delta hydrodynamics. Any fish in the Central, South, and East Delta including all the young salmon coming from the San Joaquin River system become very susceptible to Delta export. Any adult smelt migrating upstream from the Bay into the Central Delta are also susceptible. The problem here is high exports in combination with DCC operations under the 95 E/I standards.