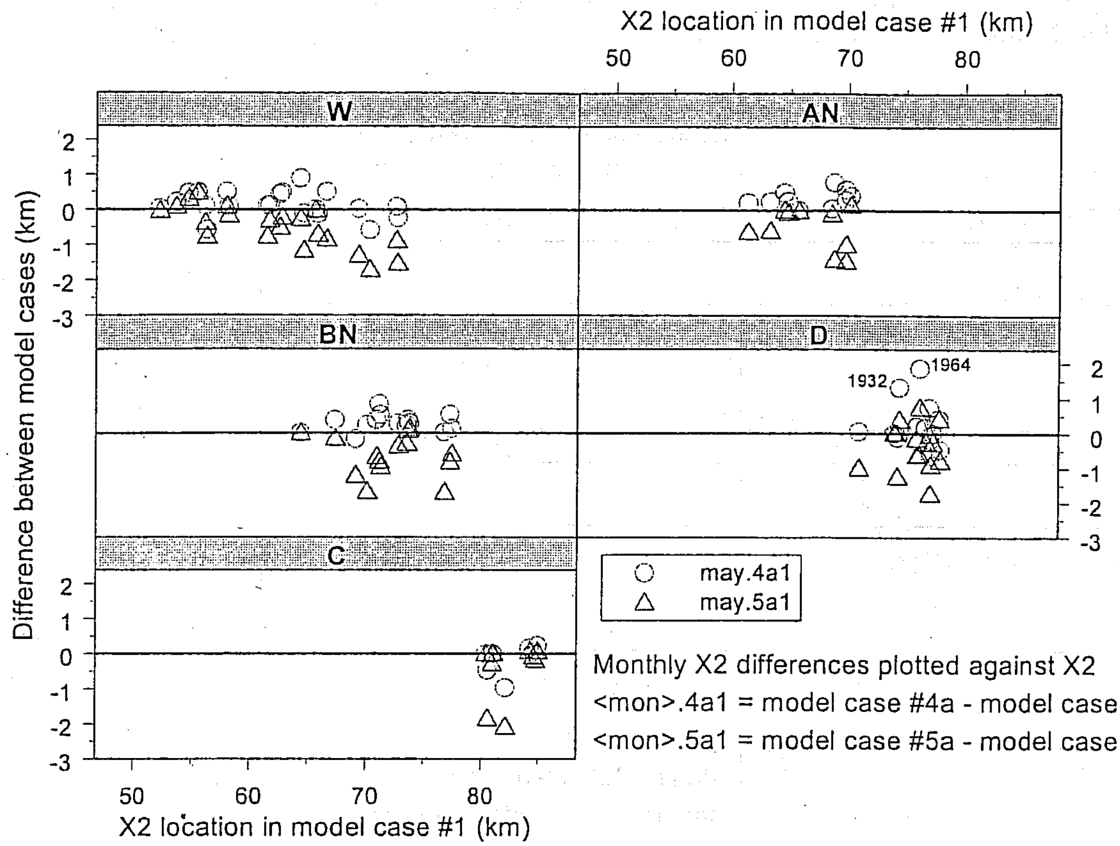


Monthly X2 differences plotted against X2
<mon>.4a1 = model case #4a - model case #1
<mon>.5a1 = model case #5a - model case #1

Figure 29 Differences in X2 under Studies #4 and #5 in May. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

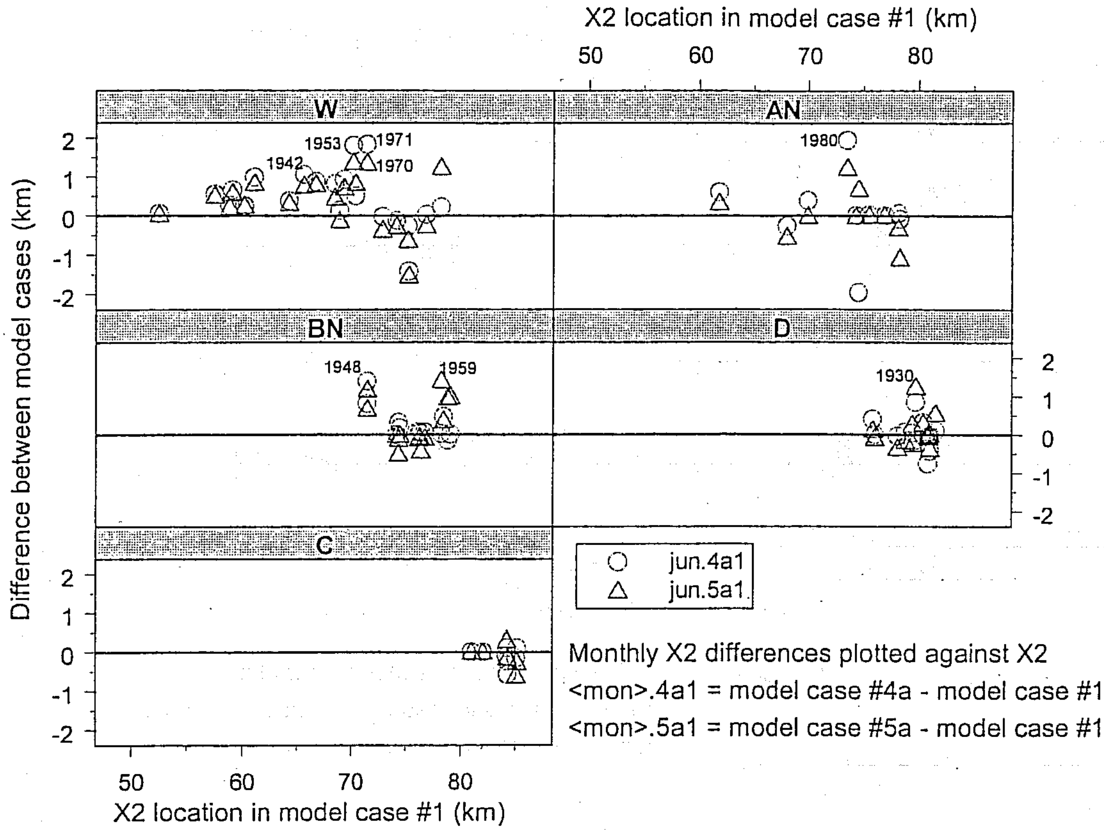


Figure 30 Differences in X2 under Studies #4 and #5 in June. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

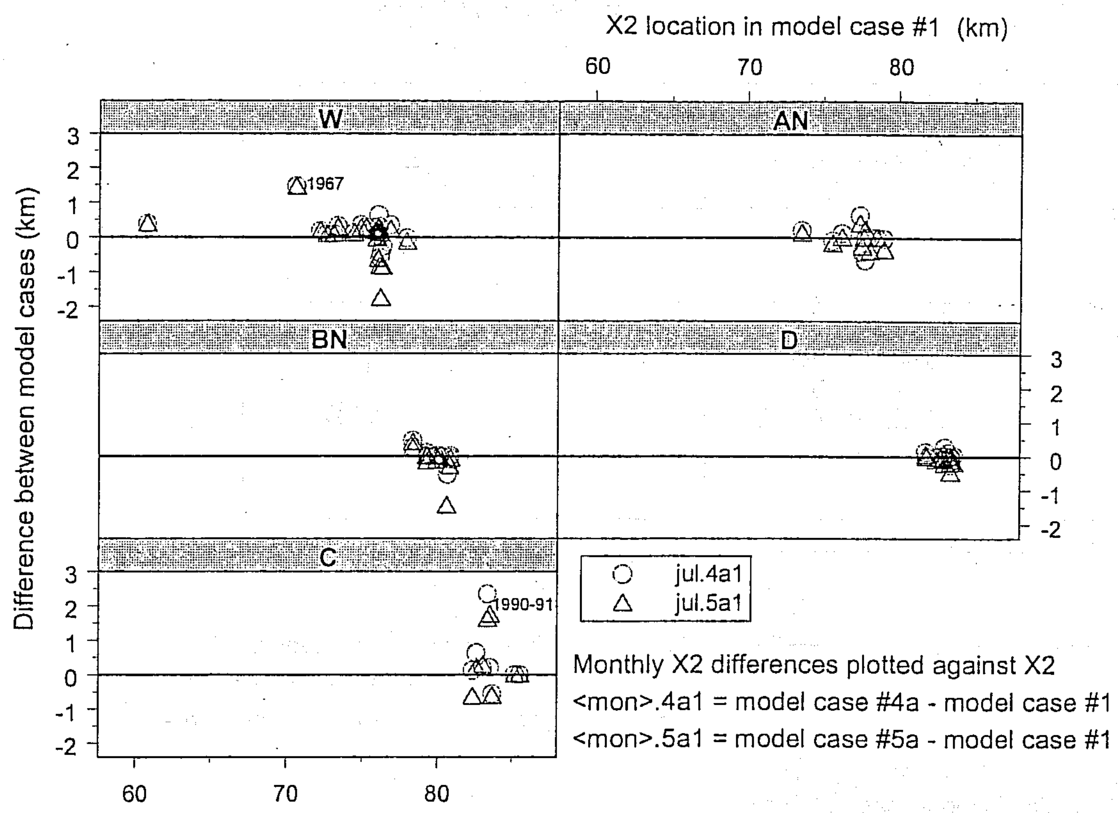


Figure 31 Differences in X2 under Studies #4 and #5 in July. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

Results

<u>March</u>

Relative to Study #1, there were two detectible upstream shifts of X2 of at least one kilometer in Dry years in Scenario #4a (1964:1.0 km; 1981: 1.5 km) and one in #5a (1981: 2.2km). Neither Study involves a movement past Chipps Island. In all three Studies the shift in the following month was downstream of the value predicted in Study #1. Most differences that occurred in March in this comparison involved a movement of X2 downstream in the future scenario.

<u>April</u>

There were no detectible differences larger than one kilometer in April.

<u>May</u>

There were two detectible differences of at least one kilometer shift upstream in Study #4a during May in Dry years (1932:1.3 km; 1964: 1.8 km). There was no occurrence in Study #5a. In Study #4a, the 1932 positive May value was followed by a smaller (0.4 km) upstream movement in June; the 1964 upstream movement in May was followed by a downstream movement in June (-0.8). The 1.3 km 1932 shift in Study #4a appears to pass Chipps Island.

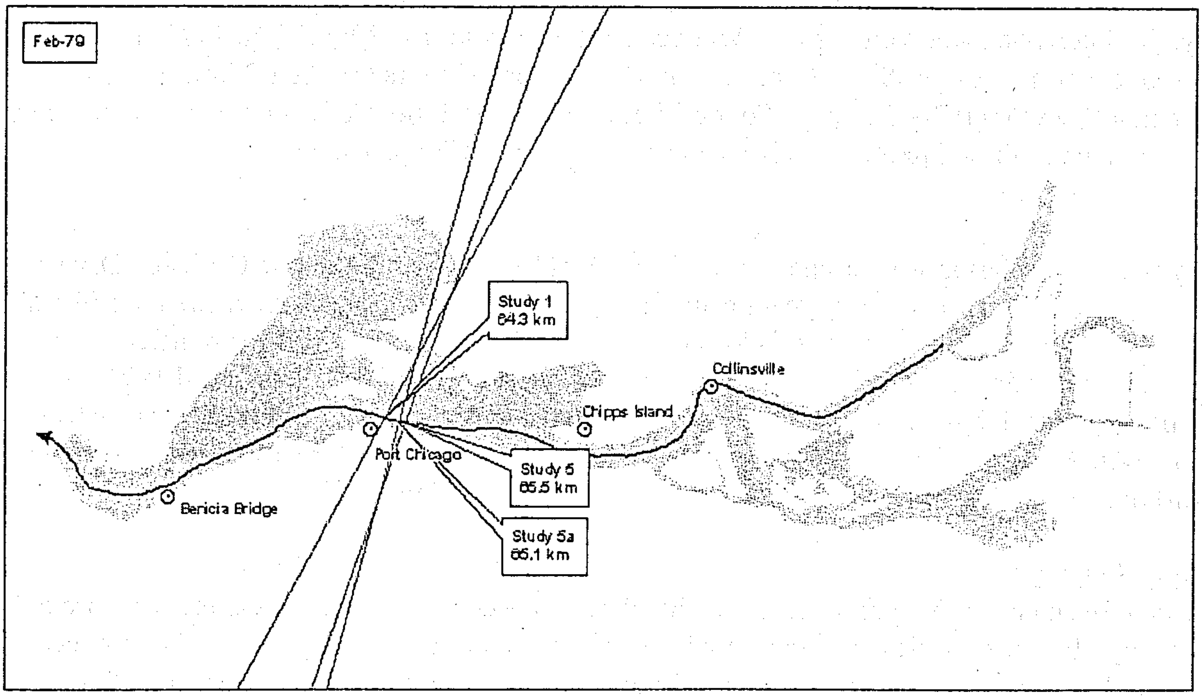
June
In June there were three differences of at least a kilometer in Study #4a in Wet years (1942: 1.1 km; 1953: 1.8 km; 1971: 1.8 km), one in an Above Normal year (1980: 2.0 km), and one in a Below Normal year (1948: 1.4 km). All of these except 1971 was followed by a smaller upstream movement in July. In Study #5a there were three in Wet years (1953: 1.4 km; 1970: 1.2 km; 1971: 1.4 km), one in an Above Normal year (1980: 1.2 km), two in Below Normal years (1948: 1.2 km; 1959: 1.4 km), and one in a Dry year (1930: 1.2 km). Four of these seven were followed by downstream movements in July. In none of these Studies does X2 appear to move past Chipps Island.

July
In Study #4a, the criterion was reached in one Wet year (1967: 1.5 km) and one Critically Dry year (1990, 2.3 km). The Critically Dry year occurrence was followed by a small downstream difference in August; the Wet year occurrence was followed by an even larger (1.8 km) upstream difference in August. In Study #5a, the criterion was reached in 1967 (1.4 km), 1990 (1.6 km), and 1991 (a Critically Dry year, 1.7 km). The two Critically Dry year occurrences were followed by negative differences in August, while the Wet year occurrence was followed by a larger upstream movement (1.8 km) in August. None of these Studies involved a shift past Chipps Island.

Modeling Summary
Upstream movements of X2 predicted in the future model Studies reach one kilometer or more only occasionally. In some Studies upstream movements observed in Study #4a are erased or reduced in Study #5a. In a few Studies the upstream movement is larger in Study #5a. There were a few movements from the west to the east side of Chipps Island, but these were of small magnitude.

CH2MHill Analysis
The CH2MHill analysis, as shown in Appendix L of the BA compared the location of X2 for February through June for the future Study as compared to the base Study (study 5A vs. study 1). The monthly X2 location was taken from the CALSIM II modeling studies. X2 locations from study 5A and study 1 were then mapped (see figure 31 for an example) to show how far X2 moved upstream. In wet years, X2 is located in Suisun Bay throughout the modeled period. An upstream movement of 0.5 km in wet years would not significantly reduce habitat quality or quantity for delta smelt. In drier years, X2 is located upstream of the confluence of the Sacramento and San Joaquin Rivers and the amount of quality habitat available to delta smelt is minimal and adult abundance is low (Bennett 2003). When X2 is located this far upstream, delta smelt would already be susceptible to increased mortality due to high temperatures, predation and entrainment. An upstream movement of X2 of 0.5 km would not be significant when it is located upstream of the confluence because smelt habitat is already poor and the upstream movement does not result in any substantial additional loss of habitat or increase in adverse effects. This analysis showed that there were 28 months (out of a possible 360 months) where X2 moved upstream more than 0.5 km. By ruling out the wet and dry years described above, the Service determined that there were 5 months out of the 28 months where the upstream movement of X2 could result in a substantial loss of habitat for delta smelt.

Figure 32



Therefore, in order to protect smelt from detrimental effects when X2 is upstream of Chipps Island, the DSRAM will be used to determine whether actions are necessary to protect delta smelt. The DSRAM and a description of it is located in Appendix A. The DSRAM has a number of triggers that determine when the Delta Smelt Working Group meets. One of the triggers calls for the Delta Smelt Working Group to meet if X2 is upstream of Chipps Island and temperatures are between 12 and 18 degrees Celsius, the approximate range of spawning temperatures for delta smelt. If this trigger is met, the Working Group will meet to evaluate whether to a change in operations such as a change in exports, San Joaquin River flows, barrier operations or cross channel gates might help protect smelt. The Working Group's recommendation will then be sent to the WOMT for consideration of implementation. Through these actions, potentially detrimental effects to delta smelt due to an upstream movement of X2 will be avoided or ameliorated.

Pumping at the CVP and SWP Facilities

Tracy Pumping

The Tracy Pumping Plant in Studies 4a and 5a the intertie allows pumping to increase to the facility design capacity of 4600 cfs (from its current pumping rate of 4200 cfs). Figure 33 shows the percentile values for monthly pumping at Tracy. November through February are the months when Tracy most frequently pumps at 4600 cfs. Tracy can better utilize the 4600 cfs pumping in wet years in Study 4a and Study 5a. As shown in Figure 33, from December through February the pumping is decreased in Study 5a by the 25 TAF/month placeholder for the EWA program. April, May and June show reductions compared to other months because of the VAMP restrictions, and May shows further reductions due to EWA spending some assets to implement the May Shoulder pumping reduction. July through September show pumping increases generally for irrigation deliveries.

Figures 34 to 39 show similar trends in monthly average exports by year type, with pumping being greatest December through February and July through September. The exception is in the Critical year (Figure 39) when the pumping stays between 1000 cfs and 1500 cfs through August due to reduced storage and water quality (salinity) in the Delta. In general, pumping at Tracy will increase in Study 5a and may increase the number of delta smelt entrained, but these increases in entrainment would be minimized by implementation of the DSRAM and use of EWA water to reduce exports.

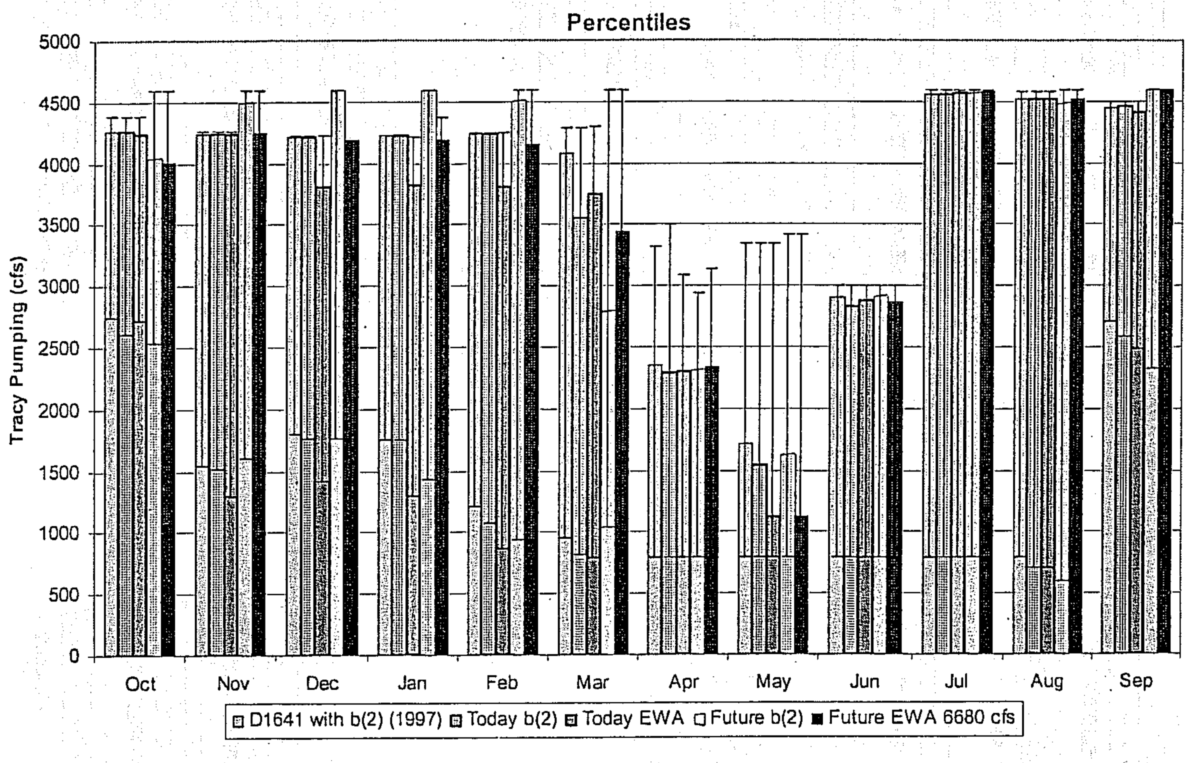


Figure 33 Tracy Pumping 50th Percentile Monthly Releases with the 5th and 95th as the bars

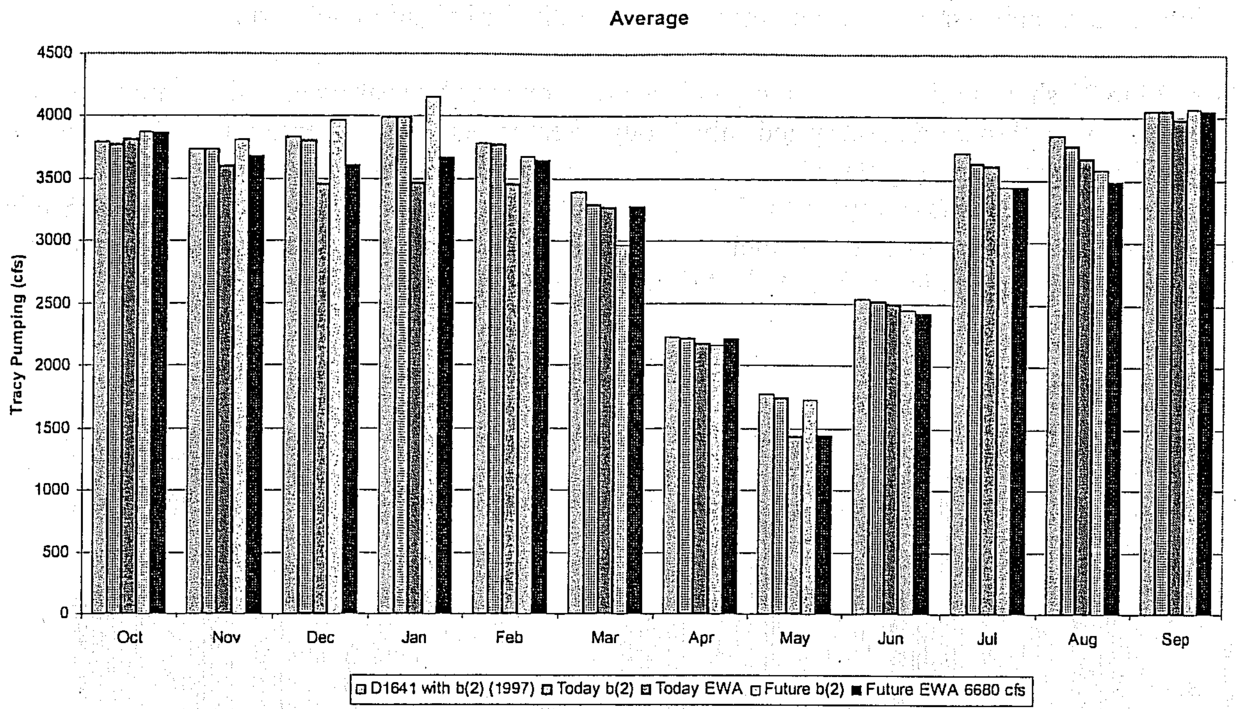


Figure 34 Average Monthly Tracy Pumping

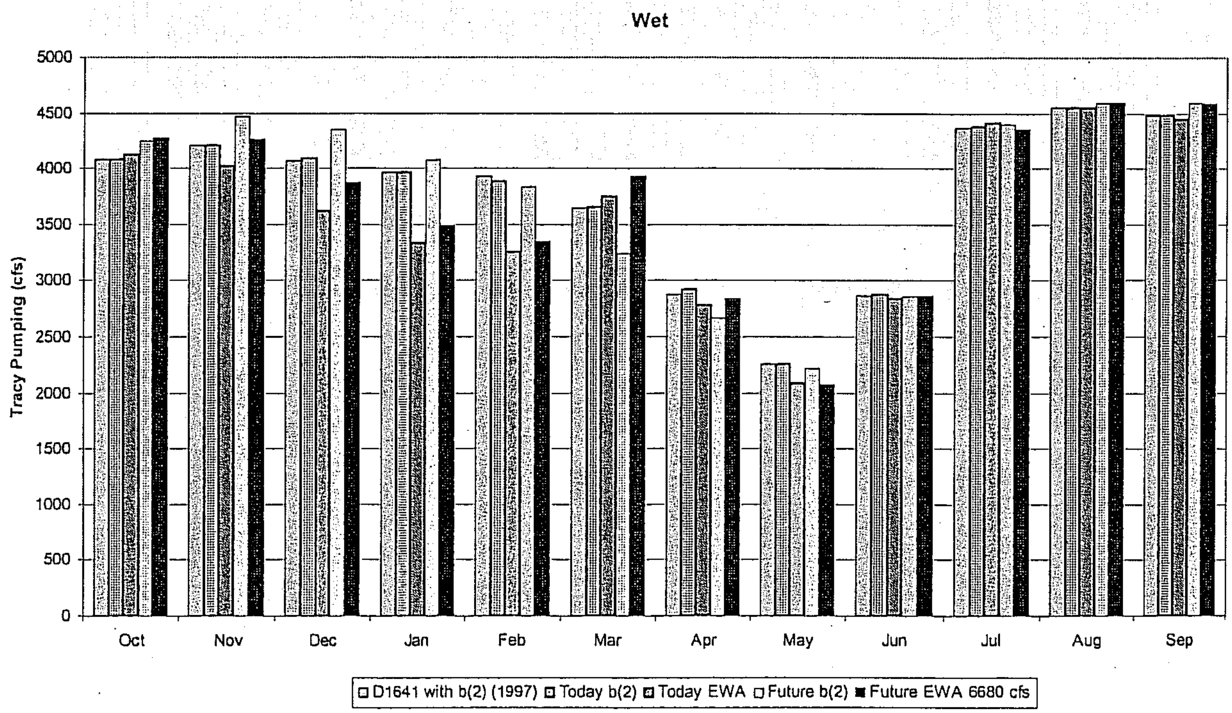


Figure 35 Average wet year (40-30-30 Classification) monthly Tracy Pumping

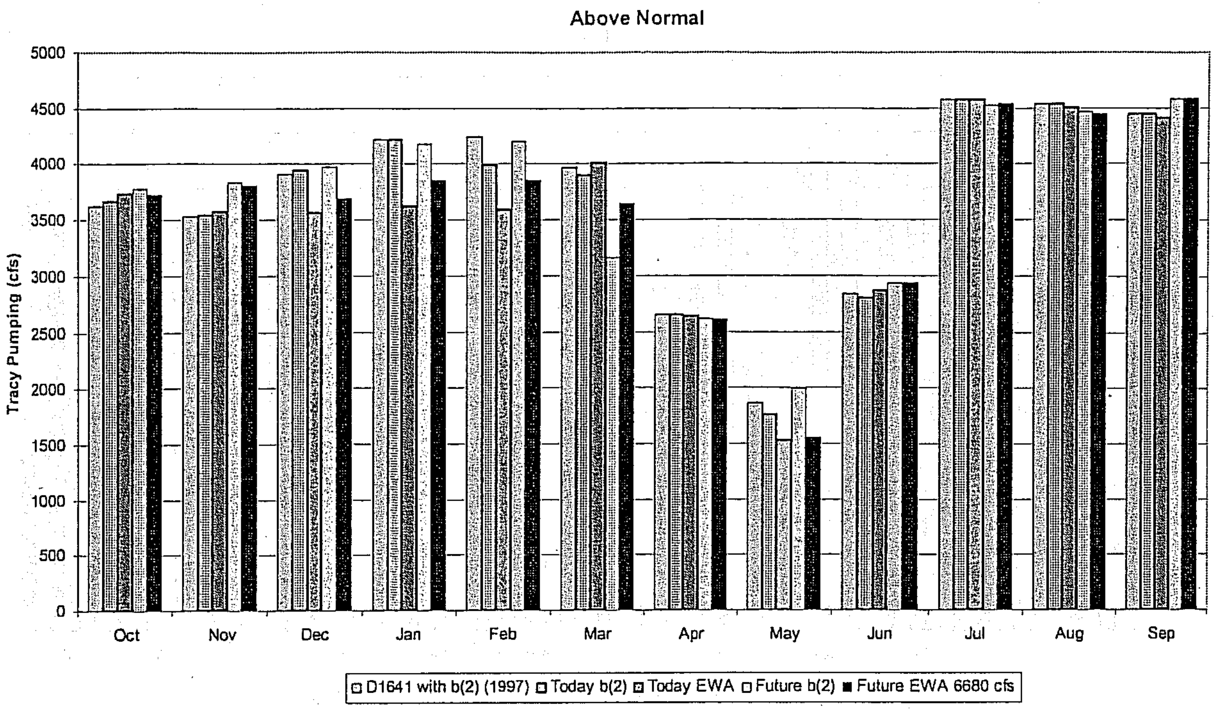


Figure 36 Average above normal year (40-30-30 Classification) monthly Tracy Pumping

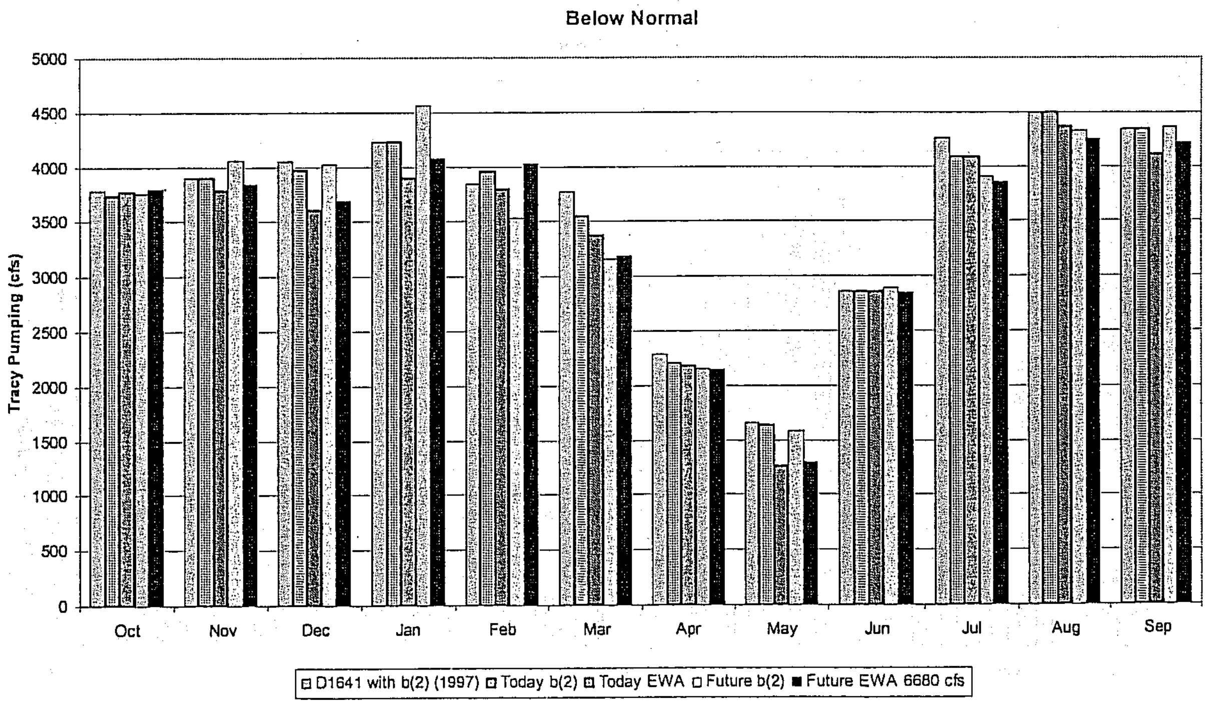


Figure 37 Average below normal year (40-30-30 Classification) monthly Tracy Pumping

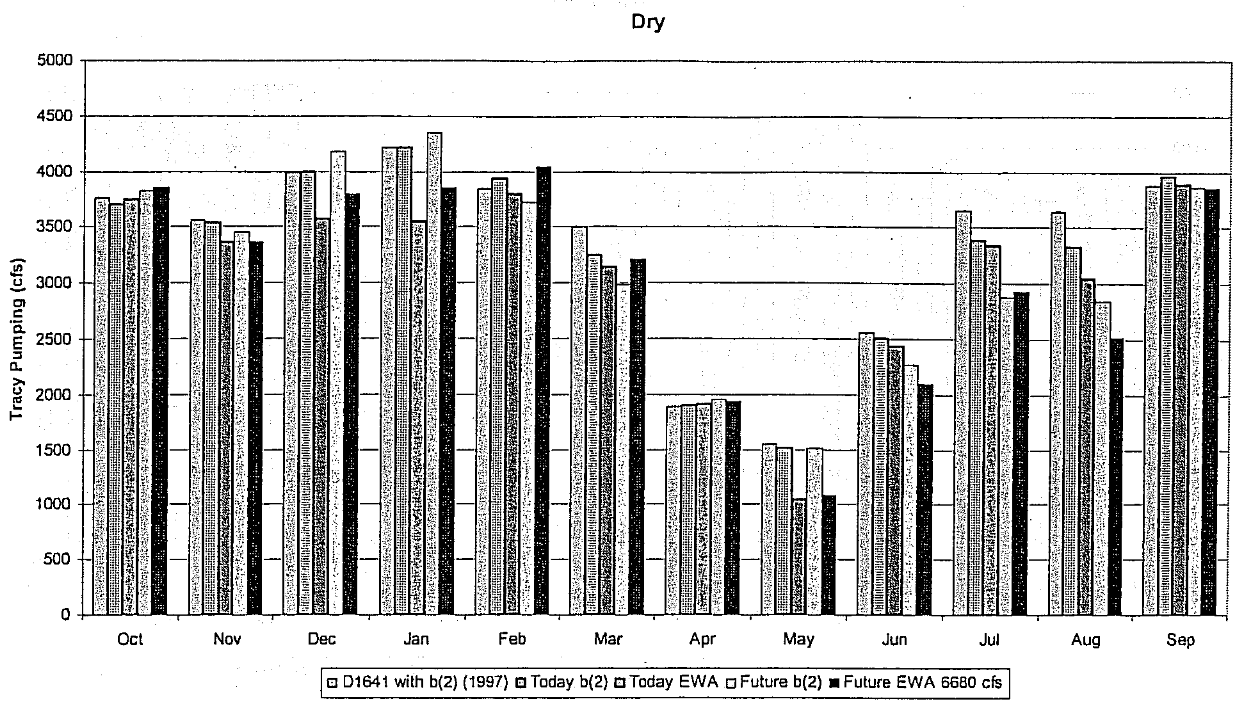


Figure 38 Average dry year (40-30-30 Classification) monthly Tracy Pumping

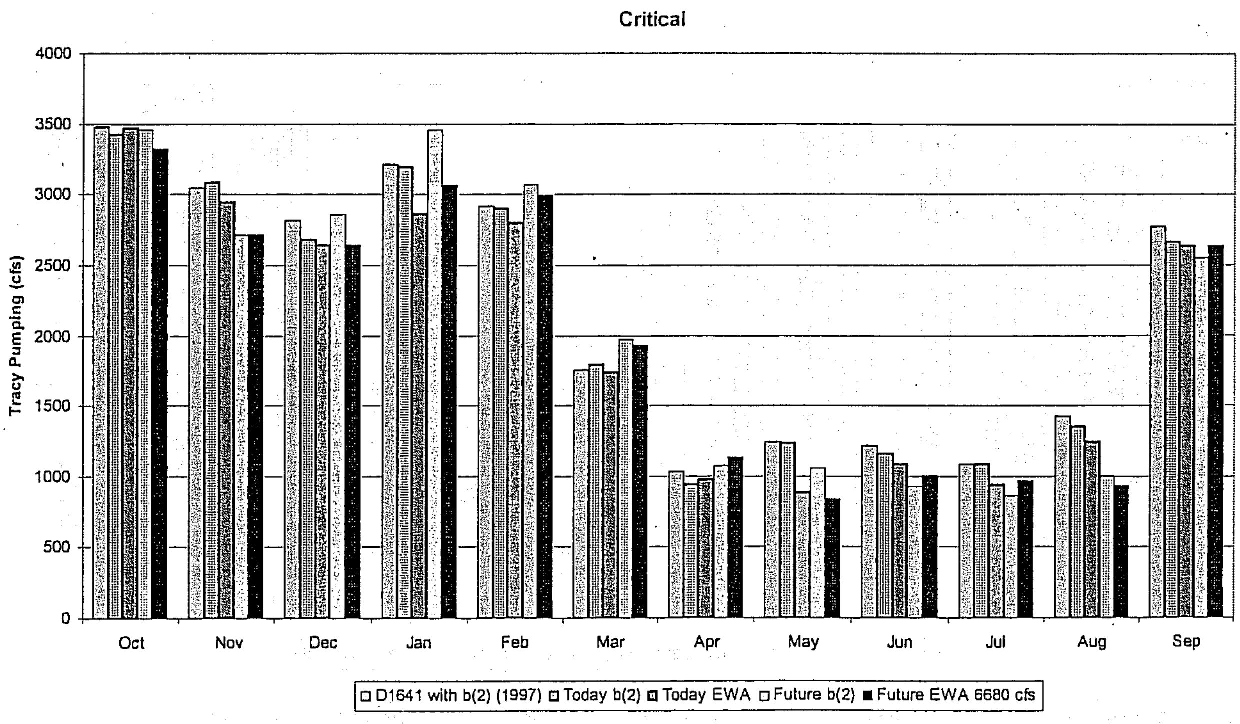


Figure 39 Average critical year (40-30-30 Classification) monthly Tracy Pumping

Banks Pumping

Figures 40 through 46 represent simulated total Banks exports for the five studies. Figure 40 shows that export levels in Studies 4a and 5a are greater export levels than Study 1.. The Future export levels are higher most months except for April and May.

While EWA and (b)(2) implementation in Study 5a results in higher export levels in all months except for April and May, the percentage of the summer time increases vary as a function of year type (Figure 41 to 46). In general, the dryer the water year, the less pumping occurs.

Most of the time EWA exports are increased primarily during the summertime to make up for reduced exports due to EWA export reductions in April and May. In general, the pumping increases in Study 5a may increase the number of delta smelt entrained, but these increases in entrainment would be minimized by implementation of the DSRAM and use of EWA water to reduce exports.

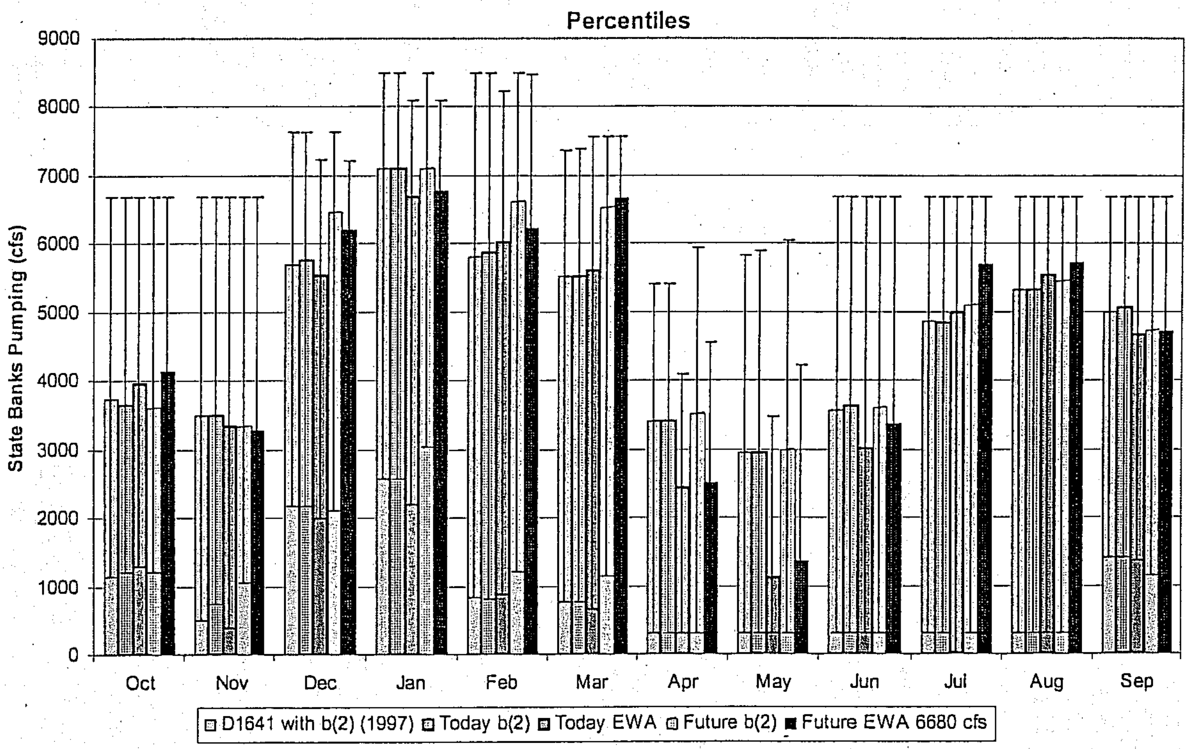


Figure 40 Banks Pumping 50th Percentile Monthly Releases with the 5th and 95th as the bars

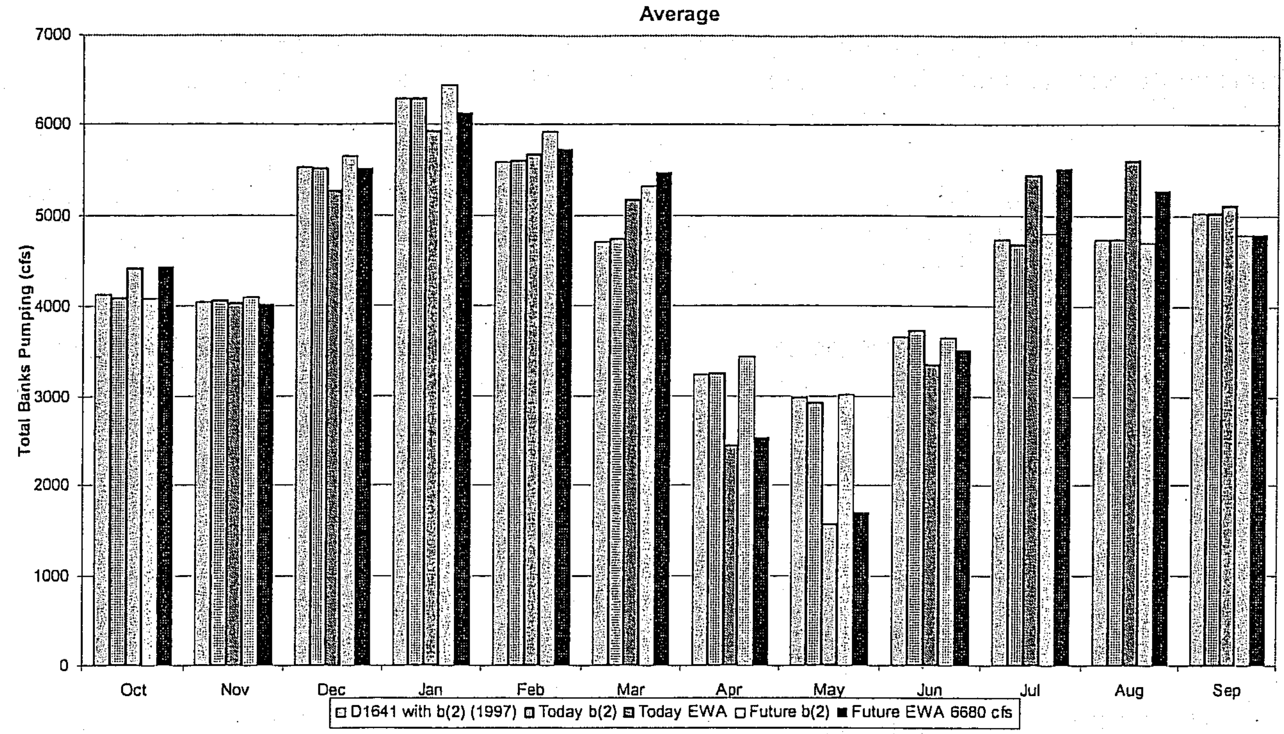


Figure 41 Average Monthly Banks Pumping

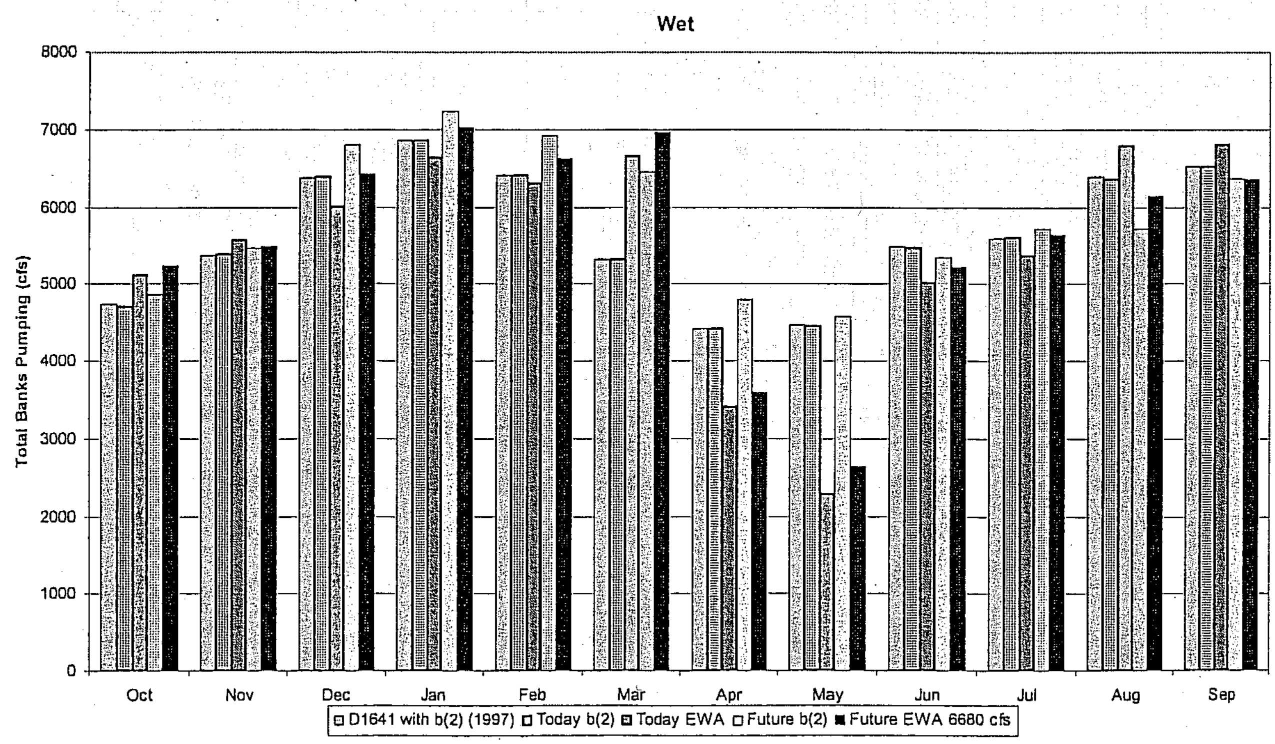


Figure 42 Average wet year (40-30-30 Classification) monthly Banks Pumping

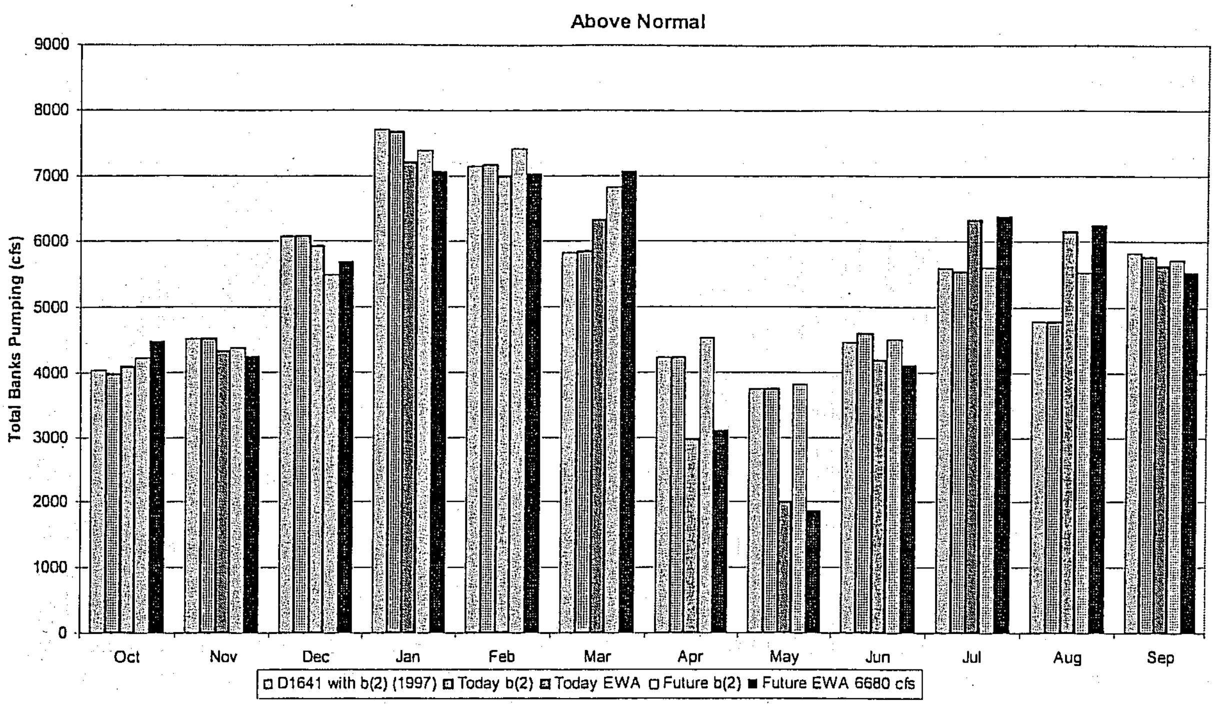


Figure 43 Average above normal year (40-30-30 Classification) monthly Banks Pumping

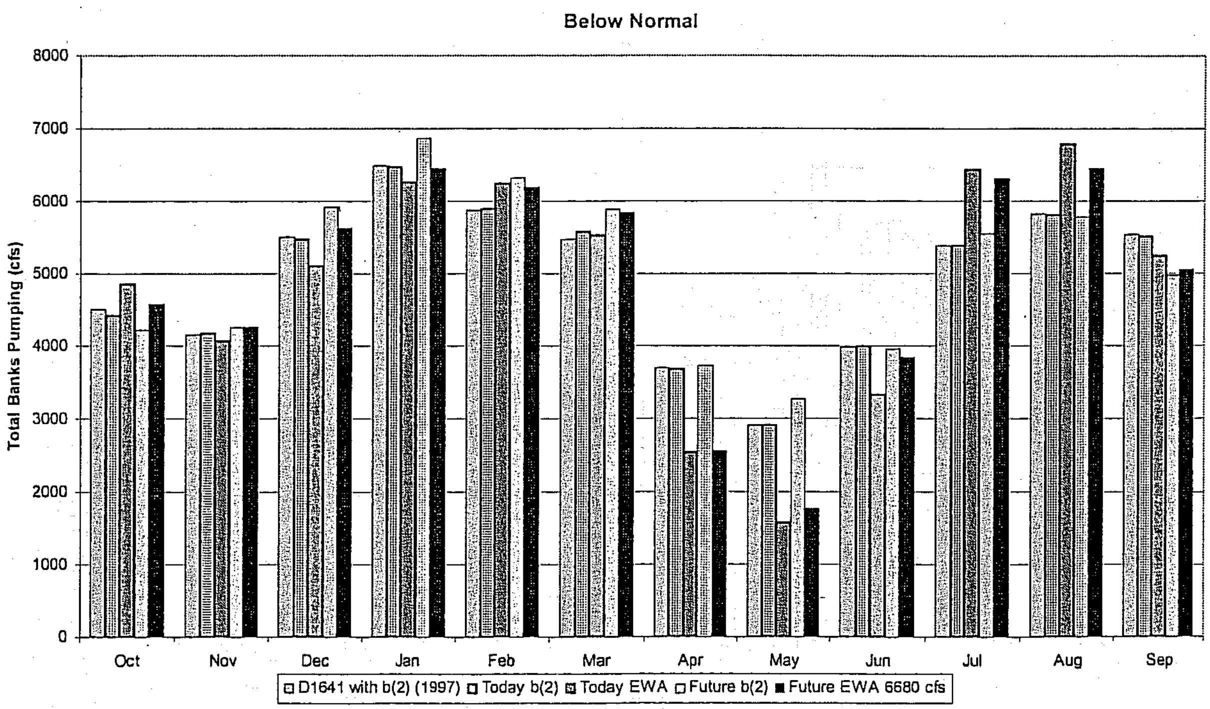


Figure 44 Average below normal year (40-30-30 Classification) monthly Banks Pumping

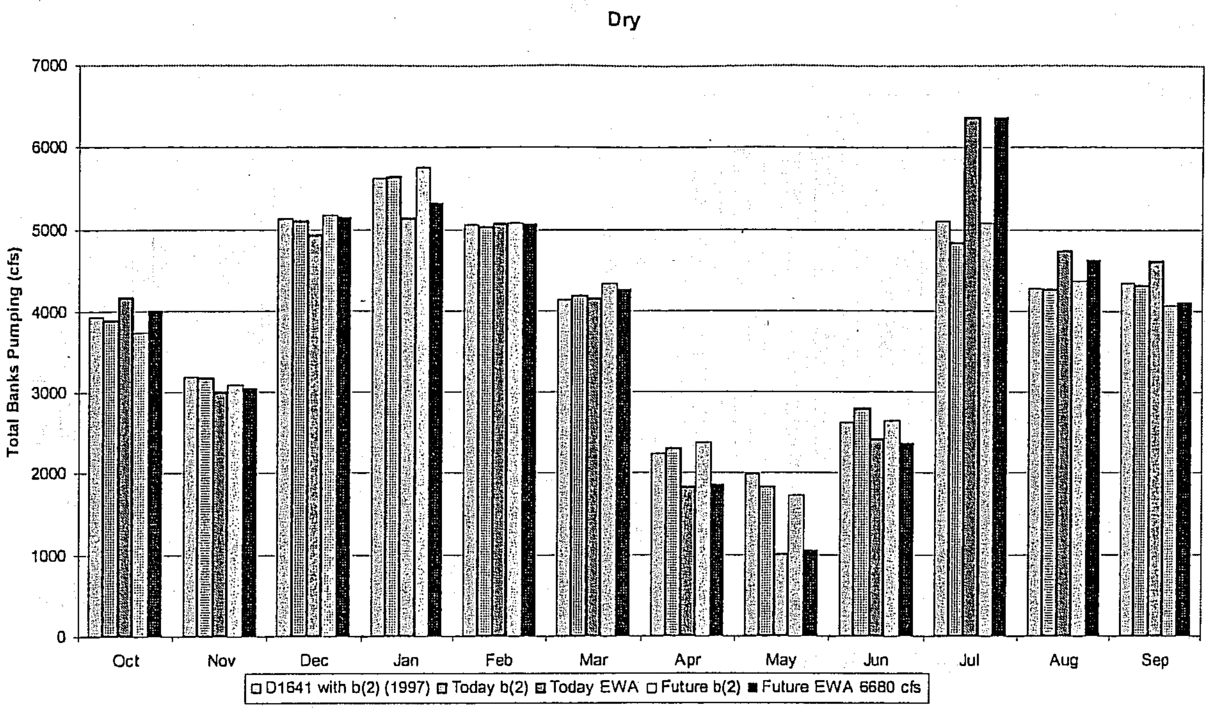


Figure 45 Average dry year (40-30-30 Classification) monthly Banks Pumping

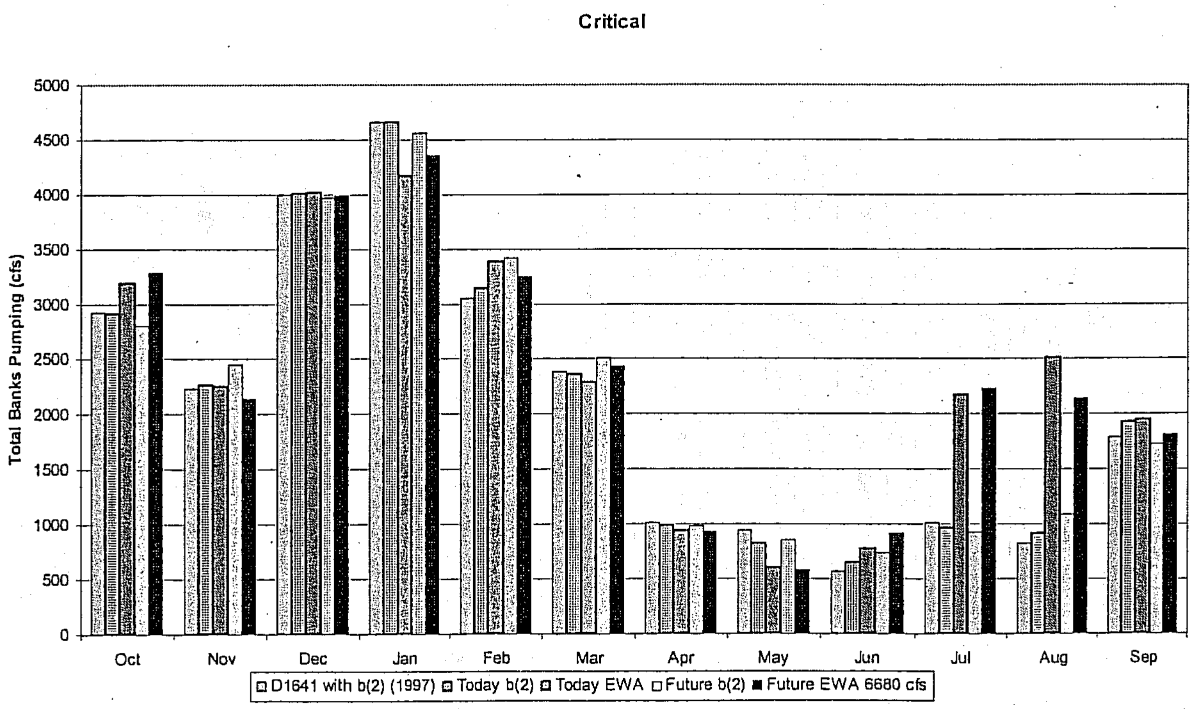


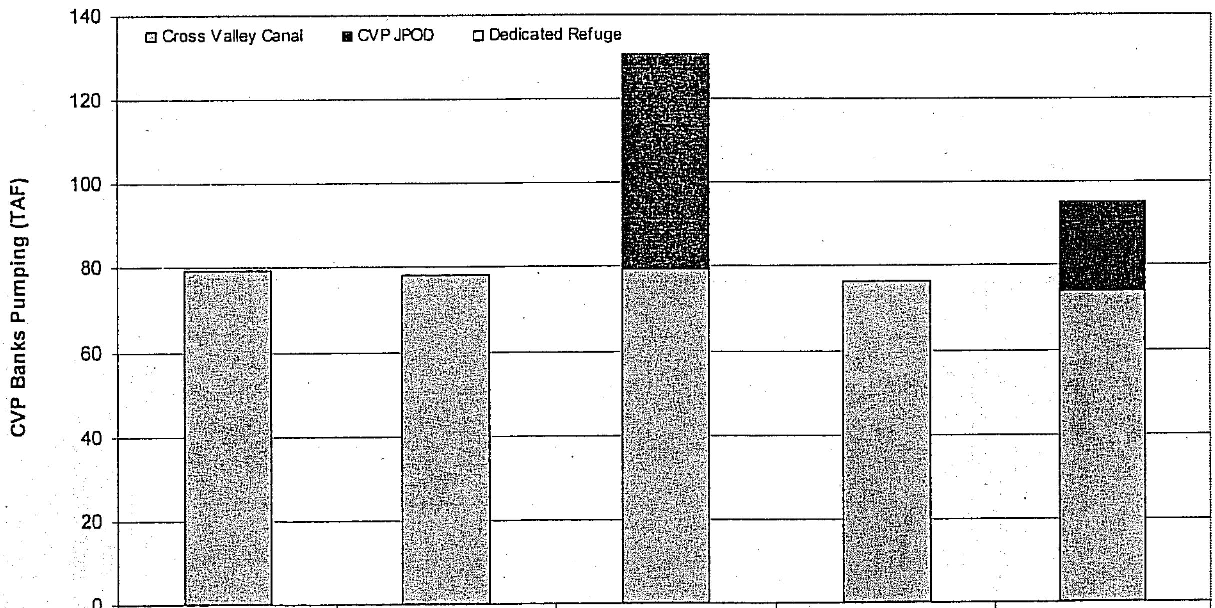
Figure 46 Average critical year (40-30-30 Classification) monthly Banks Pumping

Federal Pumping at Banks Pumping Plant (Joint Point of Diversion)

Federal pumping at Banks Pumping Plant generally occurs in the late summer, see Figure 48. Some Federal pumping occurs during October through March for Cross Valley Contractors. Joint Point of Diversion (JPOD) pumping is generally higher in Studies 3 and 5a due to CVP having the capacity to export half of the JPOD availability above the CVC pumping. Most JPOD opportunities occur in wet years with pumping averages decreasing as the years get drier.

Figure 47 shows the annual average use of Banks pumping for the CVP by study. The average JPOD pumping between the Today EWA to the Future EWA 6680 was reduced due to loss of export capacity to higher State deliveries. The Future studies do not include the dedicated 100,000 af/yr of dedicated refuge level 2 capacity at Banks. Pumping for Cross Valley Canal (Tier 1 JPOD pumping) ranges from 74 TAF to 79 TAF between the studies.

These Figures (49 to 54) show that most JPOD pumping occurs in the summer and fall, when delta smelt are not likely to be present in the south Delta. Smelt entrainment at the export facilities is not likely to increase as a result of the JPOD pumping. Since JPOD pumping also benefits the EWA, it can be considered a beneficial action when smelt are not present in the south Delta. JPOD pumping will not occur until the Management Agencies (and the Working Group, as necessary) through the WOMT determine that fish in the Delta would not be harmed.



	D1641 with b(2) (1997)	Today b(2)	Today EWA	Future b(2)	Future EWA 6680 cfs
Dedicated Refuge	0	0	0	0	0
CVP JPOD	0	0	52	0	22
Cross Valley Canal	79	78	79	76	74

Figure 47 Average use of Banks pumping for the CVP

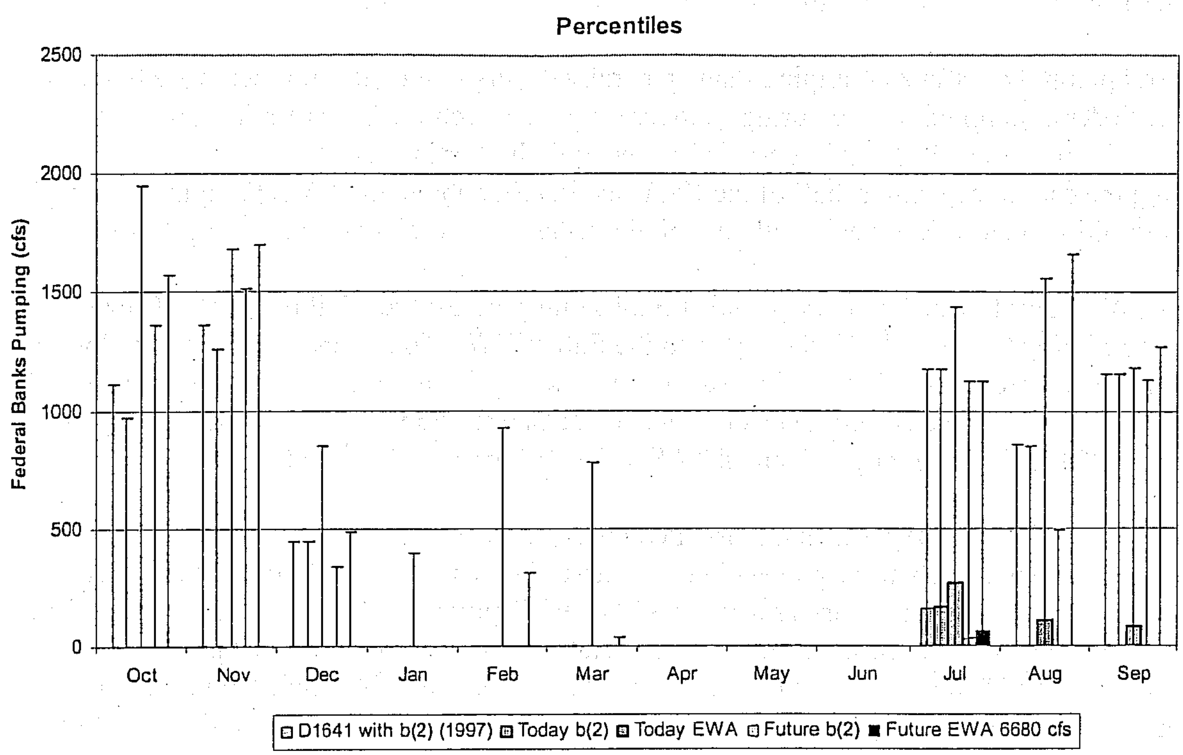


Figure 48 Federal Banks Pumping 50th Percentile Monthly Releases with the 5th and 95th as the bars

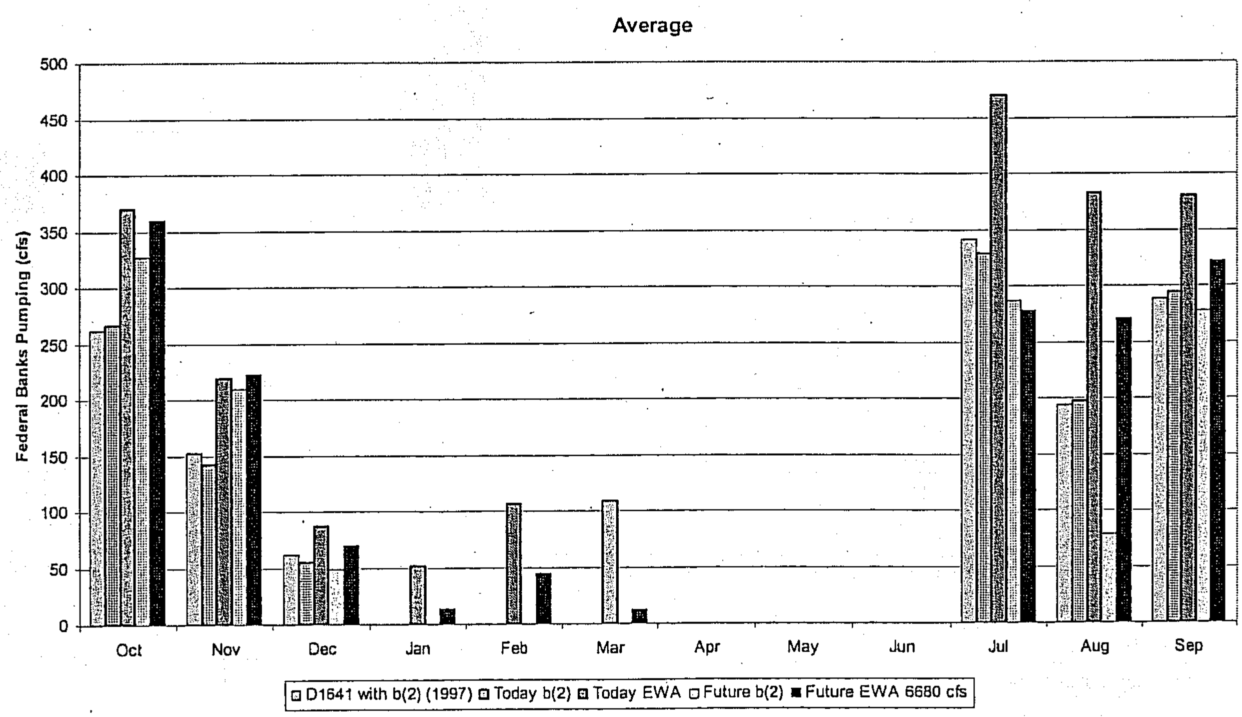


Figure 49 Average Monthly Federal Banks Pumping

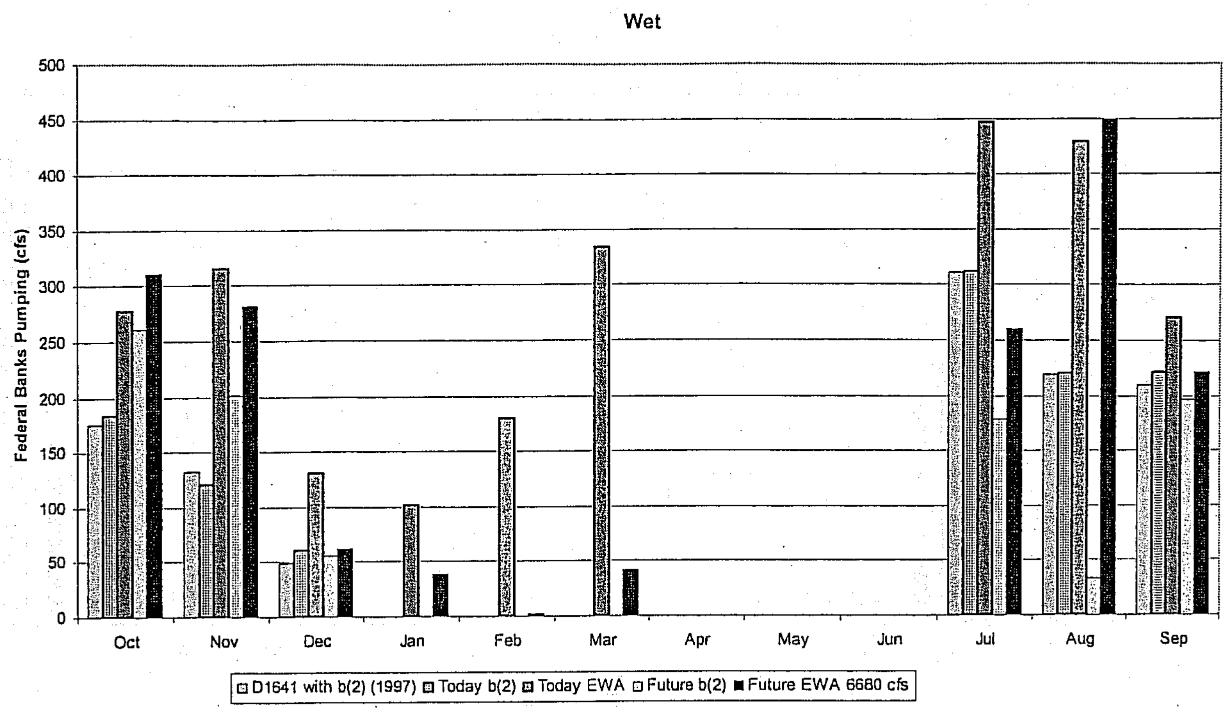


Figure 50 Average wet year (40-30-30 Classification) monthly Federal Banks Pumping

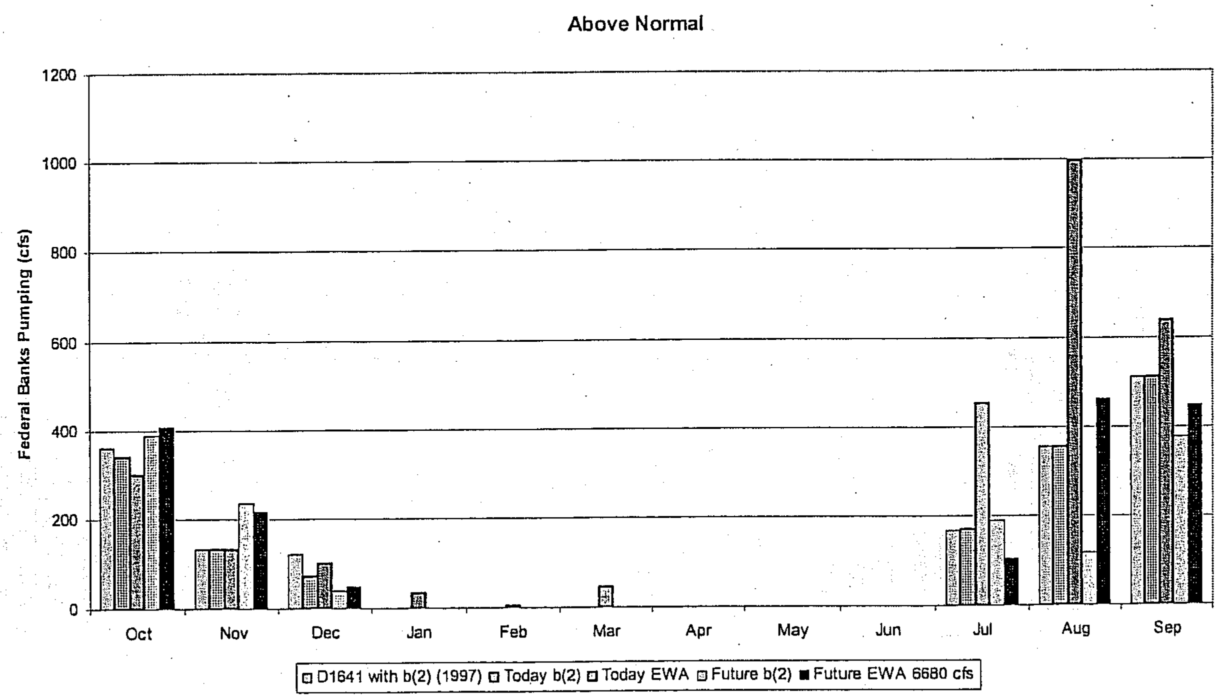


Figure 51 Average above normal year (40-30-30 Classification) monthly Federal Banks Pumping

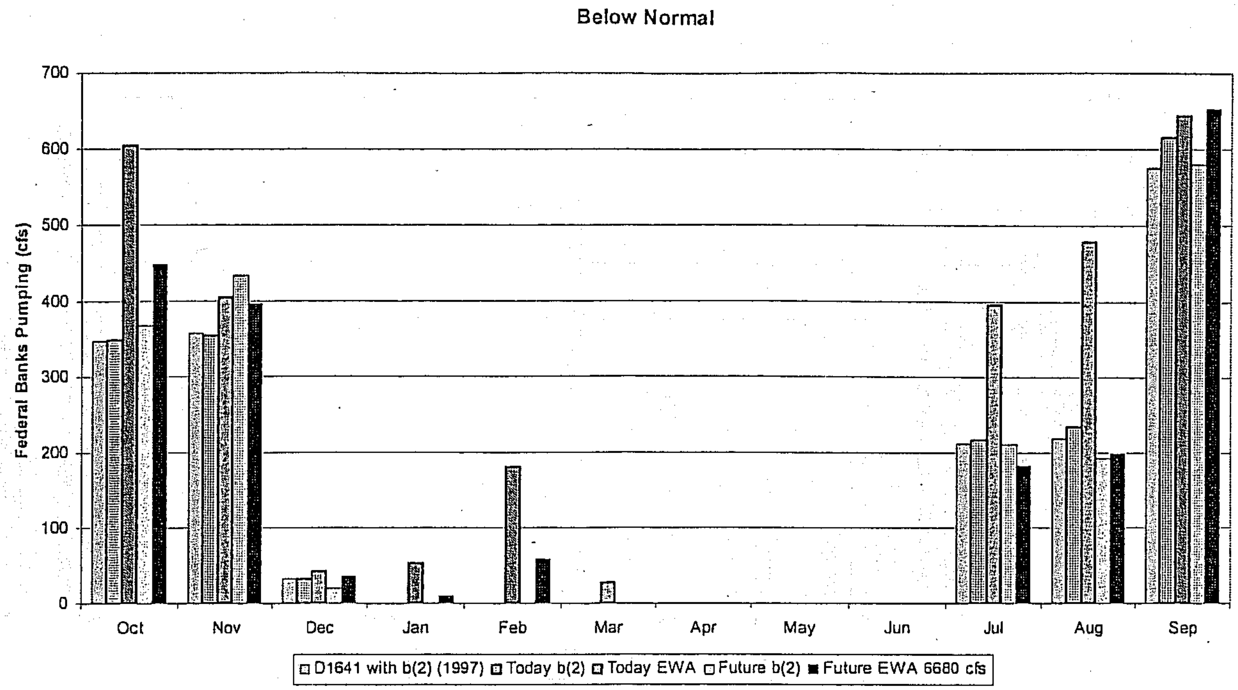


Figure 52 Average below normal year (40-30-30 Classification) monthly Federal Banks Pumping

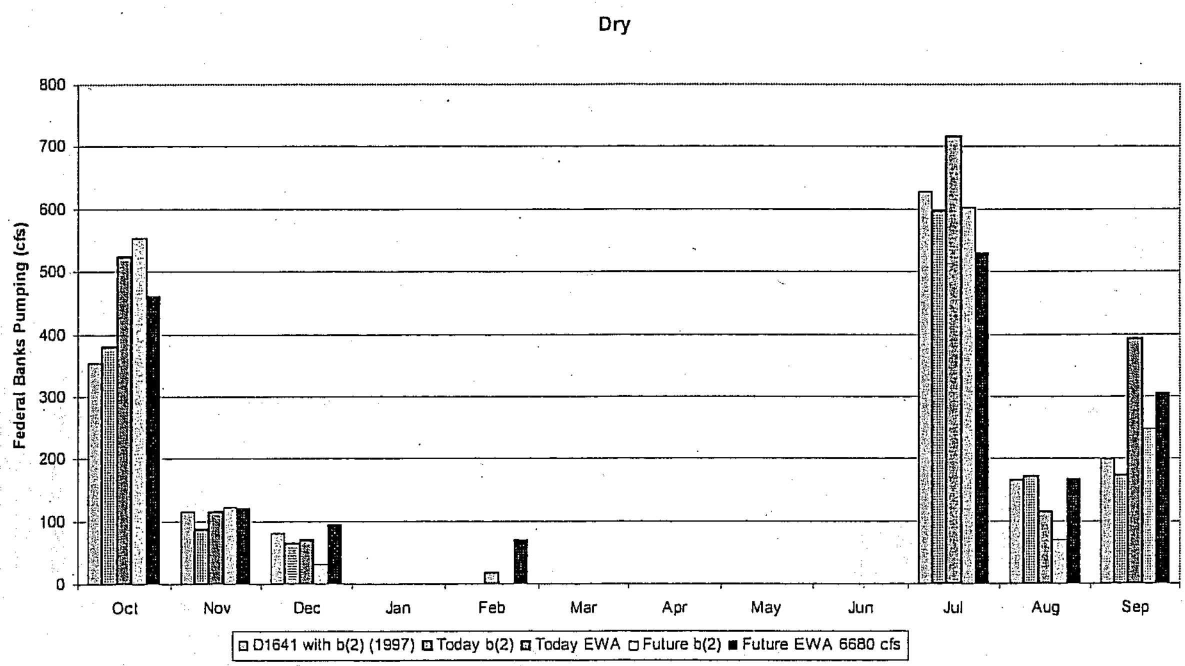


Figure 53 Average dry year (40-30-30 Classification) monthly Federal Banks Pumping

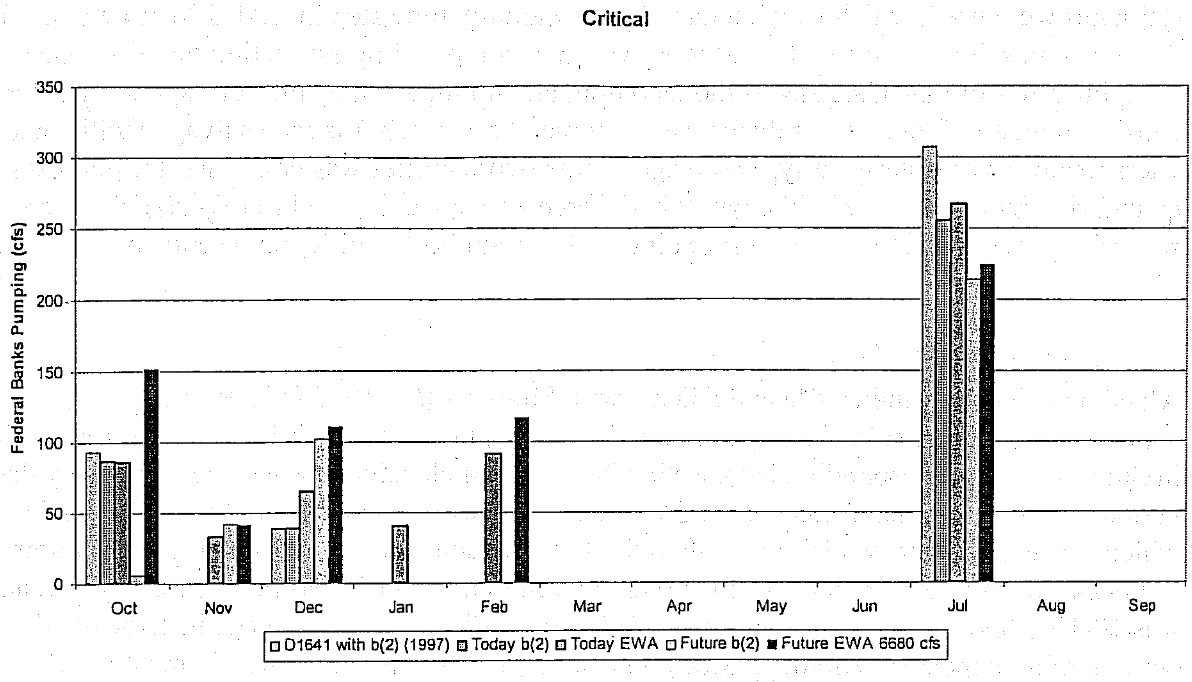


Figure 54 Average critical year (40-30-30 Classification) monthly Federal Banks Pumping

Salvage and loss (direct and indirect) at the CVP and SWP

Direct losses to entrainment by CVP and SWP export facilities

Annually, thousands of delta smelt are entrained by the Projects and unknown percentages of the entrained fish are observed and counted in fish salvage operations. Although both the CVP and SWP have fish salvage facilities, delta smelt do not survive the salvage process, either due to stress and injury from handling, trucking and release, or from predation in or near the salvage facilities, the release sites, or in Clifton Court Forebay (DFG unpublished data). Delta smelt entrainment is highly seasonal. Adult delta smelt may be present in the south Delta and vulnerable to entrainment from about December through April; larvae and juveniles are likely to be present and vulnerable during March through early July.

Delta smelt entrainment is presently estimated (or indexed) by extrapolating catch data from periodic samples of salvaged fish ($\geq$ 20 mm). A sub-sample of water from the facility holding tanks is extrapolated based on the volume of water diverted during collection of that sample to estimate the number of fish entrained into the facilities during the sampling interval. Intervals typically range from 1-24 hours depending on time of year, debris loads, etc. To simplify predictions of the difference in salvage (and by extension entrainment) between model scenarios, it was assumed that salvage density (fish per volume of water diverted) was independent of the pumping rate. Because salvage density also varies considerably among seasons and years, salvage density was estimated for wet and dry water year types from historical data representing the period 1993–2002. There were too few years of most water-year types to reasonably estimate salvage density for each type, so data from wet (Wet and Above Normal) and dry (Below Normal, Dry, and Critically Dry) types were pooled. Note that monthly mean salvage density estimates were used, which were dictated by the monthly time step in CALSIM II outputs. The difference in salvage between two Studies was then computed by estimating the difference in pumping rate from the CALSIM II model output and multiplying by the corresponding salvage density estimate. Changes in salvage were estimated separately for each salvage facility and Sacramento River water-year type (salvage for the two facilities was combined for purposes of quantifying incidental take). The monthly differences were computed as $(X_y - X_1)/X_1$ where the subscript y is either 4a or 5a (corresponding to those Studies), and X_1 represents the base Study (#1).

Salvage of adult delta smelt

All comparisons of Studies #4a and #5a are with Study #1 (the 1995 OCAP conditions). In general, there were median increases of 6-9% in CVP pumping during December through March in Study #4a. A corresponding increase in adult delta smelt salvage was expected during that period. There is a general decrease in CVP pumping during the same months in Study #5a, which was expected to result in correspondingly lower adult salvage. Median SWP pumping in Study #4a was up to 7.7% higher in February and March in Below Normal and Dry years, and was 10-13% higher in Critically Dry years. Correspondingly higher salvage in critically dry years was therefore expected. Although Study #5a was similar to the base Study in most months, median SWP pumping was up to 25% higher during March.

Table 11 CVP salvage in Wet years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	4222	+8.9%	–0.7%	0.010	+9	–1
January	4226	+8.8%	–0.8%	0.095	+140	–13
February	4243	+8.2%	–2.3%	0.151	+116	–33
March	4273	–9.0%	+7.5%	0.159	–35	+29
Largely Juveniles						
April	2747	0.0%	0.0%	0.206	0	0
May	2274	0.0%	0.0%	7.430	0	0
June	3000	0.0%	0.0%	2.017	0	0
July	4588	0.0%	0.0%	0.036	0	0
Net: December – March					+230	–17
Net: April – July					0	0

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1995-2000.
[b] Predicted median difference has unit: fishes month^{-1}. See text for explanation of calculation.

Table 12 CVP salvage in Above Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	4221	+8.9%	–0.7%	0.010	+9	–1
January	4225	+8.9%	–0.8%	0.095	+144	–13
February	4242	+8.4%	–2.0%	0.151	+151	–36
March	4262	–22.9%	–9.9%	0.159	–91	–40
Largely Juveniles						
April	2742	0.0%	0.0%	0.206	0	0
May	1911	0.0%	0.0%	7.430	0	0
June	2920	0.0%	0.0%	2.017	0	0
July	4580	+0.2%	+0.3%	0.036	+8	+11
Net: December – March					+212	–89
Net: April – July					+8	+11

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1995-2000.

[b] Predicted median difference has unit: fishes month^{-1}. See text for explanation of calculation.

Table 13 CVP salvage in Below Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	4221	+7.3%	–0.9%	0.067	+22	–3
January	4225	+8.9%	–0.8%	0.180	+133	–12
February	4241	–3.8%	+8.1%	0.235	–30	+63
March	4235	–6.7%	–8.2%	0.201	–68	–83
Largely Juveniles						
April	2321	0.0%	–1.2%	0.259	0	–16
May	1911	0.0%	–9.3%	11.93	0	–9017
June	3000	0.0%	0.0%	1.584	0	0
July	4554	+0.4%	0.3%	0.005	+9	+7
Net: December – March					+57	–35
Net: April – July					+9	–9025

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from Dry and Critically Dry years 1994 and 2001-2

[b] Predicted median difference has unit: fishes month^{-1}. See text for explanation of calculation.

Table 14 CVP salvage in Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	4220	+7.8%	–1.3%	0.067	+21	–3
January	4225	+8.8%	–0.8%	0.180	+105	–10
February	4235	+8.3%	+8.4%	0.235	+59	–60
March	4208	–9.5%	–2.4%	0.201	–75	–19
Largely Juveniles						
April	1808	+0.8%	+0.6%	0.259	+6	+5
May	1720	0.0%	–23.0%	11.93	0	–14469
June	2874	–4.1%	–14.7%	1.584	–812	–2910
July	4421	–7.5%	–3.2%	0.005	–175	–74
Net: December – March					+110	+28
Net: April – July					–980	–17448

[a] Average delta smelt salvage density (fishes $c.f.s.^{-1}$ $month^{-1}$) estimated from Dry and Critically Dry years 1994 and 2001-2

[b] Predicted median difference has unit: fishes $month^{-1}$. See text for explanation of calculation.

Table 15 CVP salvage in Critically Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	2897	–0.4%	–19.3%	0.067	–1	–41
January	4218	+6.0%	–9.6%	0.180	+61	–98
February	3979	+8.5%	+2.1%	0.235	+36	+9
March	1247	+6.8%	+0.2%	0.201	+25	+1
Largely Juveniles						
April	800	0.0%	0.0%	0.259	0	0
May	1189	0.0%	–32.7%	11.93	0	–11652
June	953	0.0%	0.0%	1.584	0	0
July	800	0.0%	0.0%	0.005	0	0
Net: December – March					+121	–130
Net: April – July					0	–11652

[a] Average delta smelt salvage density (fishes $c.f.s.^{-1}$ $month^{-1}$) estimated from pooled Dry and Critically Dry years 1994 and 2001-2

[b] Predicted median difference has unit: fishes $month^{-1}$. See text for explanation of calculation.

Table 16 SWP salvage in Wet years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	7033	0.0%	–5.6%	0.015	0	–6
January	7408	0.0%	–4.8%	0.214	0	–76
February	5848	0.1%	+6.1%	0.242	+1	+86
March	5653	+16.4%	+25.0%	0.069	+64	+98
Largely Juveniles						
April	4830	+4.4%	–21.5%	0.058	+12	–60
May	4660	0.0%	–46.6%	12.52	0	–27188
June	5925	–0.2%	–1.7%	10.9	–129	–1098
July	6680	0.0%	0.0%	0.611	0	0
Net: December – March					+65	+102
Net: April – July					–117	–28346

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1993 and 1995-2000.

[b] Predicted median difference has unit: fishes month^{-1}. See text for explanation of calculation.

Table 17 SWP salvage in Above Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	6484	0.0%	–5.7%	0.015	0	–6
January	7548	0.0%	–5.4%	0.214	0	–87
February	7451	0.0%	–5.2%	0.242	0	–94
March	5784	+21.9%	+22.9%	0.069	+87	+91
Largely Juveniles						
April	4508	–0.3%	–29.6%	0.058	–1	–77
May	3596	+0.9%	–57.6%	12.52	+405	–25933
June	3942	+0.8%	–0.3%	10.9	+344	–129
July	6157	0.0%	+7.5%	0.611	0	+282
Net: December – March					+87	–95
Net: April – July					+748	–25857

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1993 and 1995-2000.

[b] Predicted median difference has unit: fishes month^{-1}. See text for explanation of calculation.

Table 18 SWP salvage in Below Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	5938	0.0%	–5.4%	0.050	0	–16
January	7172	0.0%	–5.5%	0.209	0	–82
February	5850	+4.4%	0.0%	0.134	+34	0
March	5713	+7.7%	+6.2%	0.178	+78	63
Largely Juveniles						
April	3548	–0.3%	–27.2%	0.369	–4	–356
May	3235	+3.5%	–32.1%	29.97	+3393	–31122
June	3977	+0.3%	–0.2%	6.706	+80	–53
July	5320	0.0%	+13.4%	0.446	0	+318
Net: December – March					+113	–35
Net: April – July					+3469	–31213

[a] Average delta smelt salvage density (fishes $c.f.s.^{-1}$ $month^{-1}$) estimated from pooled Dry and Critically Dry years 1994 and 2001-2

[b] Predicted median difference has unit: fishes $month^{-1}$. See text for explanation of calculation.

Table 19 SWP salvage in Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	5358	0.0%	–5.6%	0.050	0	–15
January	5717	0.0%	–7.3%	0.209	0	–87
February	5303	+2.2%	0.0%	0.134	+16	0
March	4413	0.0%	0.0%	0.178	0	0
Largely Juveniles						
April	2168	+0.1%	–18.1%	0.369	+1	–144
May	2099	–3.0%	–51.0%	29.97	–1887	–32083
June	2952	–0.7%	–6.4%	6.706	–139	–1267
July	5217	–0.1%	+21.2%	0.446	–2	+493
Net: December – March					+16	–102
Net: April – July					–2027	–33000

[a] Average delta smelt salvage density (fishes $c.f.s.^{-1}$ $month^{-1}$) estimated from pooled Dry and Critically Dry years 1994 and 2001-2

[b] Predicted median difference has unit: fishes $month^{-1}$. See text for explanation of calculation.

Table 20 SWP salvage in Critically Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4a	Median change in Study 5a	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4a – 1	5a – 1
Adults						
December	4267	+8.2%	–5.3%	0.050	+17	–11
January	4891	–0.1%	–10.2%	0.209	–1	–104
February	3198	+13.1%	+12.0%	0.134	+56	+51
March	2030	+10.1%	+0.6%	0.178	+36	+2
Largely Juveniles						
April	1197	0.0%	0.0%	0.369	0	0
May	1189	0.0%	–20.4%	29.97	0	–7269
June	300	0.0%	0.0%	6.706	0	0
July	553	+2.9%	+70.8%	0.446	+7	+175
Net: December – March					+109	–62
Net: April – July					+7	–7095

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2

[b] Predicted median difference has unit: fishes month^{-1}. See text for explanation of calculation.

These tables show that under study 4a, an increase in the salvage of delta smelt occurs over the number of smelt salvaged in study 1 (see the second column from the right in the tables above). When the EWA is added in study 5a, the increases in salvage are reversed and take is reduced in study 1 (see the far right column in the tables above). It should be noted that the EWA as modeled only uses placeholders that reduce exports in a regular pattern during the spring and summer, and these actions do not correlate to actual salvage events at the fish facilities. In actual operations and by using the DSRAM, more informed use of the EWA actions in a proactive manner will likely reduce salvage even further.

Salvage of Juvenile Delta Smelt

Export Rates at both the CVP and SWP facilities is generally flat or declining under both #4a and #5a, with corresponding reductions in predicted salvage of juvenile smelt similar to those described for Studies #4 and #5 above. The only exceptions are SWP pumping in July of Dry and Critically Dry years, with median increases of 21.2% and 13.4%, respectively. We expect corresponding increases in salvage, however, salvage is typically near zero in July of most years, presumably because water temperatures in the south Delta are too warm for successful rearing.

It should be noted that although salvage is used to index delta smelt take, it does not reliably index delta smelt entrainment. Furthermore, delta smelt salvage is highly variable at all time scales, because they are patchily distributed, spawn at different times and places from year to year and larval dispersal is influenced by hydrodynamic conditions operating on tidal time scales. Salvage efficiencies also vary daily and seasonally due to changes in operations, size of the fish, and presumably metabolic demands of predators hunting within the facilities. Consequently, while this analysis credibly predicts what might happen in typical years, there will (even under the "baseline" Study 1 scenario) certainly be a small percentage of future years in which the confluence of natural and anthropogenic circumstances cause large delta smelt entrainment episodes. Delta smelt typically spend more time closer to the export facilities under low-flow conditions and in relatively cool years with low to intermediate flows, making these episodes more likely under those conditions. Because an analysis of the likelihood of these events would require modeling delta smelt movement using detailed historical distributional data that does not exist, we cannot determine whether the frequency of large entrainment events would be different from Study #1 under Study #4 or #5. More sophisticated models and shorter time-scale monitoring of young smelt distribution may provide a means to resolve this question in the future. (BA 2004)

Salvaged numbers of delta smelt do not adequately reflect the actual number of smelt that are lost at the CVP and SWP. The current salvage facilities use a louver system that is efficient for salmon and striped bass, but has unknown efficiency for delta smelt. Predation on delta smelt in Clifton Court Forebay also affects the salvage efficiency at the SWP. The collection, handling and transport studies (CHTR) currently underway propose to evaluate methods to improve handling, such that some delta smelt may survive the salvage process. In addition, a more complete understanding of the salvage efficiencies at the projects would improve estimates of the number of delta smelt entrained.

Article 21 Effects

The assumptions in CALSIM II for the demands that drives Banks Pumping varies by month with some variation across years. The demand for Article 21 water is one component of this total demand. In general, the assumed demand December through March for Article 21 water in CALSIM II is 134 taf per month–the assumed demand December through March Article 21 accounts for 90 percent of the annual total. With this assumed demand, 400 taf or more of Article 21 water is diverted 10 percent of the time (see Figure 10-46 of the BA).

It is likely that if the demand is assumed higher in these months, more may be diverted. To test this sensitivity DWR staff conducted an auxiliary simulation based on Study 2 with a demand set at 203 taf January through March (in the original Study 2, demand is never fully met in December) and with a demand of 300 taf January through March. With these higher demands 400 taf or more of Article 21 water is delivered 26 percent of the time. One other result worth noting is that based on Study 4 (a future conditions study with the same Article 21 demands as Study 2), there is an 8 percent chance of delivering 400 taf or more Article 21 water between December and March in any given year.

These differences are appropriately illustrated in the larger context of total SWP diversions from the South Delta in Figure 10-47 of the BA. For example, there is a 32 percent chance that Banks Pumping will total 1600 taf or more December through March assuming an Article 21 demand of 134 taf/month; the chances increase to 36 percent assuming an Article 21 demand of 203 taf/month and 41 percent assuming an Article 21 demand of 300 taf/month. These differences are best characterized with the probabilistic exceedance plots. Nevertheless, a similar characterization is illustrated in Figure 10-48 of the BA, which depicts the total Banks diversions with the different Article 21 demands averaged by water year type. A corollary look at the effects on the position of X2 is presented in Figure 10-49 of the BA.

The effects of Article 21 pumping on delta smelt are not expected to be very significant. The most pumping of Article 21 water occurs during above normal or wet water years, when delta smelt are not likely to be near the projects. Also, outflows and X2 requirements will continue to be met during Article 21 pumping, so delta smelt habitat is not likely to be significantly affected by the pumping of Article 21 water. An increase in smelt take at the TFCF or at the Skinner Fish Facilities could occur as a result of Article 21 pumping if delta smelt are present in the south Delta at the time of the pumping.

Intertie Effects

The DMC and CA Intertie (Intertie) consists of construction and operation of a pumping plant and pipeline connections between the Delta Mendota Canal and the California Aqueduct. The Intertie would include a 400 cfs pumping plant to allow up to 400 cfs to be pumped from the DMC to the CA. Up to 950 cfs could be conveyed from the CA to the DMC using gravity.

The Intertie would allow the Tracy pumping plant to export to its authorized capacity of 4,600 cfs (currently 4,200 cfs), subject to all applicable export pumping restrictions for fishery protections and water quality. These increased export amounts were modeled in the CALSIM II modeling and salvage is expected to increase as a result of the increase in maximum pumping at Tracy up to 4,600 cfs. The effects of the increase in the number of delta smelt salvaged at the Tracy fish facilities is described in the Salvage and Loss section of the Effects section.

Water Transfers Effects

Water transfers would increase Delta exports from 200,000-600,000 AF in about 80% of years. Most transfers would occur during July through September. Delta smelt are not likely to be present in the south Delta during this time (DFG unpublished data). However, delta smelt may still inhabit parts of the Delta in the zone of influence in July of some years. Water transfers may also occur outside of the July through September period and would be subject to all current water quality and pumping restrictions. As described in the project description, transfers will take place at times when delta smelt will not be adversely affected by the transfer and Reclamation and DWR will coordinate these transfers through the B2IT, EWAT and WOMT. The effects of transferring the water for terrestrial species would need to be handled in a separate Section 7 consultation.

Conservation Measures

A number of conservation measures are expected to continue in the future as part of the proposed project. These measures provide protection for delta smelt and/or their habitats and it is important to continue these protections to maintain or improve delta smelt populations that use the Delta. These baseline conditions will continue in the future as part of the project description and will help provide protection to delta smelt throughout its life cycle. These measures are further described in the Project Description.

Water Rights Decision 1641

Under the Water Quality Control Plan, flows and water quality objectives help maintain delta smelt habitat quality during their early life stages. In particular, X2 and E:I ratio requirements to reduce delta smelt entrainment risk (for more details see the X2 effects section).

VAMP

The Vernalis Adaptive Management Plan provides pulse flows in the San Joaquin River and lower Delta exports during April and May which is thought to improve transport and habitat conditions for delta smelt.

EWA

The Environmental Water Account, as modeled, reduces exports during periods considered critical to delta smelt. Primarily via export reductions, it helps reduce salvage at the CVP and SWP. It provides an important adaptive management mechanism to benefit delta smelt.

CVPIA (b)(2)

Water that is part of the CVPIA (b)(2) account can be used to reduce exports at the SWP and CVP. These reductions help reduce entrainment of smelt in the same way that EWA does.

Adaptive Management process

The Adaptive Management section of the Project Description describes a number of groups and teams which meet to discuss potential operational actions to be taken to benefit delta smelt. These groups use the salmon decision tree and the DSRAM to determine a concern level and which actions are appropriate to protect fish. The delta smelt working group uses the DSRAM to determine if the level of concern is sufficient to recommend an action to be taken to protect smelt. By using the various groups and teams, proactive actions may help avoid high salvage events and improve habitat conditions.

Summary of Effects

In summary, the operations of the Projects under formal consultation as described in the Project Description will result in adverse effects to delta smelt through entrainment at the CVP and SWP and by drawing delta smelt into poorer quality habitat in the south delta. However, with the inclusion of the conservation measures described above and the implementation of the DSRAM, these adverse effects would be avoided or minimized. With these conservation measures in place, the re-operation of the Trinity River, the increased level of development on the American

River, the Freeport Diversion, the Suisun Marsh Salinity Control Gates, the Barker Slough Diversion, or due to changes to X2, as described in the Project Description, are not expected to result in adverse effects delta smelt.

Critical Habitat Effects

Critical habitat is not likely to be adversely modified or destroyed as a result of the formal consultation proposed project. The primary constituent elements essential to the conservation of the species will not be affected by the proposed project. Pumping at the CVP and SWP pumping facilities as a result of the proposed project will not result in a loss of physical habitat in the delta. River flows and water in the delta will continue to be adequate to provide spawning, rearing and foraging habitat for the smelt. The salinity of the delta will not be modified beyond the normal fluctuations as a result of this project, as the location of X2 during February through June will not change significantly as a result of this project. No breeding habitat will be affected by the proposed project, and the sustainability of the food base for delta smelt will not be changed by the proposed project. In addition, adequate flows and reduced exports during the delta smelt spawning and rearing seasons will protect delta smelt and these protections will remain in place as long as the WQCP 1641 requirements continue to be met.

Overall CVP/SWP Effects-Early Consultation

The "Early Consultation" effects described in this biological opinion includes the proposed operations of components of the South Delta Improvement Program. These operations include pumping of 8500 cfs at the SWP, permanent barrier operations in the south Delta, the long term EWA, water transfers, and CVP and SWP operational integration. (See Table 21).

Table 21 Summary of formal and early consultation assumption differences

	Early Consultation	Formal Consultation
South Delta Improvement Plan	X	
DMC Intertie	X	X
CVP/SWP Project Integration	X	
Freeport	X	X

Effects of the re-operation of Trinity Reservoir

Trinity effects as part of early consultation are the same as for formal consultation. Therefore, the effects to smelt from operations on the Trinity River are expected to be same for early consultation.

Although the proposed changes in CVP operations resulting from implementation of the Trinity River Fishery Restoration Program will result in decreased flow down the Sacramento River, this change in flows is anticipated to result in minimal effects to delta smelt and delta smelt habitat. Flows to the Sacramento River will be reduced (see figure 9-6 of the biological assessment) and the timing of water movement into and through the Sacramento watershed would change as a result of these changes in CVP operations. The reduction in flows could have an additional small effect on the location on X2, which in turn could affect delta smelt. Smelt are usually distributed around the location of X2 from February through June. An upstream movement of X2 could cause smelt to be distributed further upstream into the east and south delta, where they could be more susceptible to entrainment at the export facilities and at local diversions in the Delta and increased mortality due to high temperatures or predation.

The CH2MHill Trinity analysis (dated November 5, 2003) mapped X2 location outputs from CALSIM II modeling. This analysis included only the effects of the Trinity River added to the "today" Study. The outputs showed that upstream movements of X2 greater than 0.5 km due to increased flows in the Trinity River occurred in a total of 26 months. The Service then analyzed the upstream movements of X2 and eliminated upstream movements in X2 in the 73 year record in wet years or in dry years. In wet years, X2 is located in Suisun Bay, which provides a shallow, protective, food-rich environment for delta smelt. An upstream movement of 0.5 km in wet years would result in an X2 location that would still be located in Suisun Bay, which would not be significant for delta smelt since substantial high quality habitat would still be available. In dry years, X2 is located upstream of the confluence of the Sacramento and San Joaquin Rivers and the habitat available to smelt is poor and the upstream movement does not result in any substantial additional loss of habitat or increase in adverse effects. When X2 is located upstream of Chipps Island, smelt would already be susceptible to entrainment or mortality due to high temperatures. The critical thermal maximum for delta smelt was experimentally determined to be 25.4 degrees Celsius in the laboratory (Swanson et al., 2000); and at temperatures above 25.6 degrees Celsius smelt are no longer found in the Delta (DFG, pers. comm.). By ruling out wet and dry years, the Service determined that there were 2 months (out of a possible 355 months) where the upstream movement of X2 could result in a substantial loss of habitat for delta smelt. The delta smelt risk assessment matrix (DSRAM, see project description) includes a trigger for the delta smelt working group to meet when X2 is upstream of Chipps Island during the period from February to June. If this trigger is met, the delta smelt working group may recommend an action to be taken to minimize effects to delta smelt (see DSRAM process discussion in the project description). Use of the DSRAM and subsequent implementation of recommendations made by the delta smelt working group, where practicable, will minimize the effects of movement of X2 on delta smelt resulting from the reduction of Trinity River water diverted down the Sacramento River. Therefore, the Service has determined it is not necessary to provide specific reasonable and prudent measures to reduce effects to delta smelt from the proposed changes in CVP operations resulting from implementation of the Trinity River Fishery Restoration Program.

Effects of Increased Level of Development on the American River

American River effects for the early consultation are the same as under the formal consultation.

The greatest impact to the American River is the increases in demands from the 2001 (Today) to the 2020 (Future) Level of Development (LOD). The actual deliveries, based on long-term average, increase from a total of 251,000 af in the 2001 LOD to 561,000 af in the 2020 LOD. The ability to fill Folsom Reservoir in May is reduced from 50 % of the time to 40 % of the time between the Today and Future runs (see Figure 9-47 of the BA). Carryover September storage in Folsom Reservoir is reduced by 30,000 to 45,000 af on a long-term average basis from the Today to the Future Study.

Effects to delta smelt from these lower amounts of water from the American River cannot be specifically determined from the CALSIM II modeling. Generally, a higher American River LOD will not result in an overall change of delta smelt habitat through a change in outflows or the location of X2 since more water would be released from Shasta if needed to make up for the reduction in American River water. Less American River water may reduce flexibility for Reclamation and DWR to meet WQCP requirements and may contribute to lower Reservoir storages else ware in the system.

Effects of the Freeport Diversion

Effects from the Freeport Diversion for the early consultation are the same as under the formal consultation.

The Freeport Regional Water Authority (FRWA) has a design capacity of 287 cfs (185 million gallons per day). Up to 132 cfs would be diverted under Sacramento County's existing Reclamation water service contract and other anticipated water entitlements and up to 155 cfs of water would be diverted under EBMUD's amended Reclamation water service contract. Under the terms of its amendatory contract with Reclamation, EBMUD is able to take delivery of Sacramento River water in any year in which EBMUD's March 1 forecast of its October 1 total system storage is less than 500,000 af. Additionally, EBMUD can only take 133,000 af in any one year, not to exceed 165,000 af in any consecutive 3-year drought period. Modeling shows that EBMUD takes an annual max of 94,000 af five times in the 73 years that are analyzed (1939, 1959, 1962, 1968 and 1987). The 165,000 af limit is reached in two consecutive years 3 times (1929-1930, 1959-1960, and 1987-1988) and in three consecutive years 4 times (1962-1964, 1976-1978, 1977-1979 and 1990-1992). Table 9-55 in the biological assessment shows the average annual Freeport diversions by water year type.

Effects to delta smelt from water diversions at Freeport would be similar to the increased American River demands in that the specific effects of the Freeport diversions cannot be determined from the CALSIM II analysis. Again, losses of water in the Sacramento River due to higher demands on the American River would be made up with additional water from other parts of the system and outflows and X2 are not likely to be affected by the Freeport diversions. This consultation does not authorize the construction activities required for the Freeport diversion.

Suisun Marsh Salinity Control Gates

Effects from the Suisun Marsh Salinity Control Gates are the same as under the formal consultation. The Suisun Marsh Salinity Control Gates impair free movement of delta smelt into or out of Montezuma Slough. Smelt in Montezuma Slough when the gates are down may be subject to entrainment due to private and state-owned diversions. Smelt may also be subject to increased predation at the gates by predatory fish.

Effects of Diversions in Barker Slough/North Bay Aqueduct

The effects from Barker Slough/North Bay Aqueduct under early consultation would be the same as the formal consultation effects.

Analysis of the effects of the North Bay Aqueduct is based on monitoring required under the March 6, 1995 OCAP Biological Opinion. Specifically, the 1995 Biological Opinion required the Department of Water Resources (DWR) to monitor larval delta smelt in Barker Slough, from which the North Bay Aqueduct (NBA) diverts its water. Since then, monitoring has been required every other day at three sites from mid-February through mid-July, when delta smelt may be present. As part of the Interagency Ecological Program, DWR has contracted with the Department of Fish and Game to conduct the required monitoring each year since the Biological Opinion was issued.

Data from the past 9 years of monitoring show that catch of delta smelt in Barker Slough has been consistently very low, an average of just five percent of the values for nearby north Delta stations (Cache, Miner and Lindsay sloughs) (Figure 55). In other words, sampling over the past decade indicates that a relatively small portion of the delta smelt population in this region is typically susceptible to NBA diversions. Moreover, recent research by the Interagency Ecological Program indicates that well-designed positive barrier fish screens (such as those used by NBA) effectively limit smelt entrainment. These results are consistent with Nobriga et al. (2004), who found that a small diversion with a positive barrier screen resulted in no entrainment of delta smelt, despite the fact that the diversion was located in a region of high delta smelt density.

In summary, NBA diversions do not appear to have had a substantial effect on delta smelt. The proposed operations are sufficiently similar to indicate that the effect of NBA on smelt will continue to be relatively low.

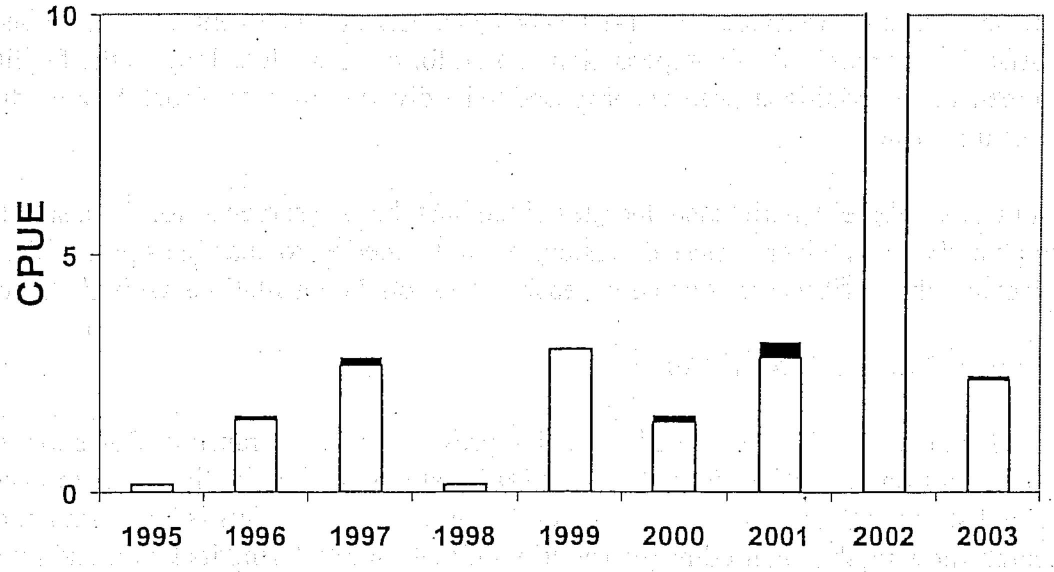


Figure 55 Comparison of delta smelt catch-per-unit-effort (fish/trawl) for NBA monitoring sites in Barker Slough (dark bars) to nearby north Delta sites: Lindsay, Cache and Miner sloughs (white bars). The NBA values are the mean annual CPUE for stations 720, 721, and 727. The nearby North Delta sites represent the mean annual CPUE for stations 718, 722, 723, 724, and 726

Based on these findings, the Delta Smelt Working Group (Working Group) has recommended a broader regional survey during the primary period when delta smelt are most vulnerable to water project diversions. An alternative sampling approach would be conducted as a 1-2 year pilot effort in association with the DFG's existing 20-mm survey (http://www.delta.dfg.ca.gov/data/20mm). The survey would cover all existing 20-mm stations, but would have an earlier seasonal start and stop date to focus on the presence of larvae in the Delta. The proposed gear type is a surface boom tow, as opposed to oblique sled tows that have traditionally been used to sample larval fishes in the San Francisco Estuary. Under the proposed work plan, the Working Group will evaluate utility of the study and effectiveness of the gear in each year of the pilot work. This new monitoring effort may give a better understanding of the abundance and distribution of larval delta smelt and may help the Working Group in its recommendations to WOMT to change project operations to protect smelt. This monitoring study may result in the harm, or harassment of delta smelt. Incidental take associated with this study is included in the incidental take in this biological opinion.

Effects of Rock Slough and other CCWD Diversions

The effects from the Rock Slough and other CCWD diversions are the same as under the formal consultation. The Contra Costa Water District (CCWD) diverts CVP water from the Delta for irrigation and M&I uses. The Rock Slough diversion can divert up to 350 cfs and is not currently screened for delta smelt. CCWD's biological opinion for the Los Vaqueros Reservoir required the Rock Slough diversion to be screened for delta smelt. Reclamation requested an extension to the screening requirement until 2008, when the use of Rock Slough will be determined by the proposed Los Vaqueros expansion project. The Service granted this request in a letter dated

December 10, 2003 (Service File #1-1-04-F-0034). Effects due to entrainment of delta smelt will be offset by the purchase of compensation habitat for delta smelt as long as the facility remains unscreened. No additional water is proposed to be diverted from the Rock Slough diversion as a part of this project.

Contra Costa Water District also operates diversions that are screened for delta smelt at Mallard Slough and on Old River. These diversions are not expected to change as part of the proposed project and their effects are covered in separate Section 7 consultations with the Service.

Effects of Changes in X2 Location

The X2 standards in D-1641 were intended to provide adequate transport flows to move delta smelt away from the influence of the CVP/SWP water diversion facilities into low-salinity rearing habitat in Suisun Bay and the lower Sacramento River. This is based on previous research showing the longitudinal distribution of delta smelt during its larval and juvenile stages is related to flow magnitude and its correlate, X2 position (Sweetnam and Stevens 1993; Dege and Brown 2004). Therefore, during the larval and juvenile phases, river flows of sufficient magnitude and duration facilitate down-estuary movement from spawning habitats in the delta to rearing habitats.

Young delta smelt are usually distributed upstream of X2 (Sweetnam 1999; Dege and Brown 2004). A recent study showed that since the sudden population decline in the early 1980s, upstream placement of X2 during spring is associated with low delta smelt abundance in the DFG Tow-net Survey (Kimmerer, 2002). Prior to the 1982, the opposite was true: delta smelt abundance was highest when X2 was in or near the delta. Currently, the central and south delta are generally no longer suitable habitat for post-larval delta smelt due to entrainment losses and/or altered habitat conditions. Thus, D-1641 requires the X2 location to meet certain requirements from February through June, as described in the project description. The CALSIM II modeling considers the D-1641 standard to be the baseline condition. However, in certain years, hydrologic conditions may result in the X2 standard not being met for as many days as in the baseline. Even if D-1641 X2 standard continues to be met, there could be adverse effects to delta smelt if X2 moves upstream of Chipps Island in the future Study. Since delta smelt generally move with X2, a further upstream location of X2 near Chipps Island in the future Study could result in a distribution pattern wherein more delta smelt would be susceptible to entrainment and elevated mortality in the Central and South Delta due to high temperatures or predation. The critical thermal maximum for delta smelt under laboratory conditions is 25.4 degrees Celsius (Swanson et al., 2000); and at temperatures above 25 degrees Celsius smelt are no longer found in the Delta (DFG, pers. comm.). South delta temperatures can approach 25 degrees Celsius in May and June, and exceed 25 Celsius during summer months. The future Study could result in an upstream movement of X2 due to increased pumping at the CVP, increased American River demands, the Freeport diversion, and less water from the Trinity River.

Two analyses were done to assess the effects of the proposed project on the movement of X2 and subsequent effects to delta smelt: an analysis using CALSIM II modeling and a graphical analysis by CH2MHill. The CALSIM modeling results was done by Reclamation and used a 1 kilometer change in X2 location as a criterion and are presented in the biological assessment. The CH2MHill analysis used a half kilometer change in the location of X2 as a criterion and is presented in Appendix L of the biological assessment.

CALSIM II Analysis
The X2 position in CALSIM II represents where the 2 ppt isohaline lies, as calculated from the monthly average Net Delta Outflow (NDO). Since the model represents the end of month X2 position, the day-to-day effects of CVP/SWP operations are not shown in the CALSIM II representation.

Figure 56 shows the exceedance plot for monthly differences in X2 position between the Studies for all February to June values simulated. Operational changes in Study 2 – Study 1 have minor influence on the X2 position. Operational changes in Study 3 have a greater effect than those in Study 2 due to EWA effects on pumping operations. The largest effect on X2 is in Study 5 compared to Study 1 this comparison shows the cumulative effect on X2 with 0.5 km shifts occurring about equal on either side of the curve.

The monthly average X2 position based on long-term and water year type-dependent averages are shown in Figures 57 to 62. The six Figures generally indicate the same trend from February to June in the X2 position on average as it moves more upstream into the Delta. Also in the months February, April, May, and June the X2 position shifts slightly downstream in the early consultation study when compared to the other Studies which were modeled. However, sporadic upstream movements of X2 may have adverse effects.

Figure 63 to 67 show the X2 position sorted from wettest to driest 40-30-30 Index and show the variability within a particular group of water years. These results show that X2 moves upstream as the water years get drier. Figure Figures 68 to 70 show the total number of days that the X2 position is downstream of one of the three compliance points (Confluence, Chipps Island and Roe Island) varies annually. These latter results represent gross approximations because CALSIM II must estimate "the total number of days" values based on monthly, rather than daily, simulation results. These graphs indicate that average changes to X2 under the proposed actions for formal consultation are minor (i.e. within the measurement error of X2 position). For further definition of the modeled CALSIM II studies, see Table 10 in the beginning of the effects section.

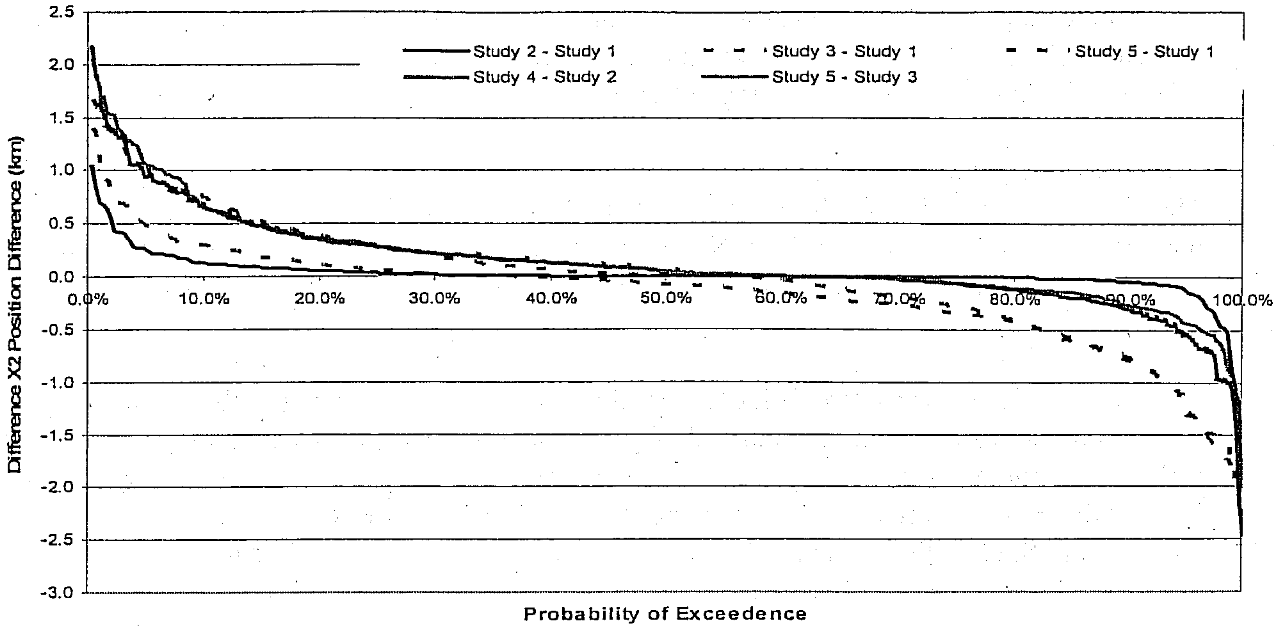


Figure 56 Probability of Exceedance for Monthly Shifts in X2 Position for the Feb – June Period

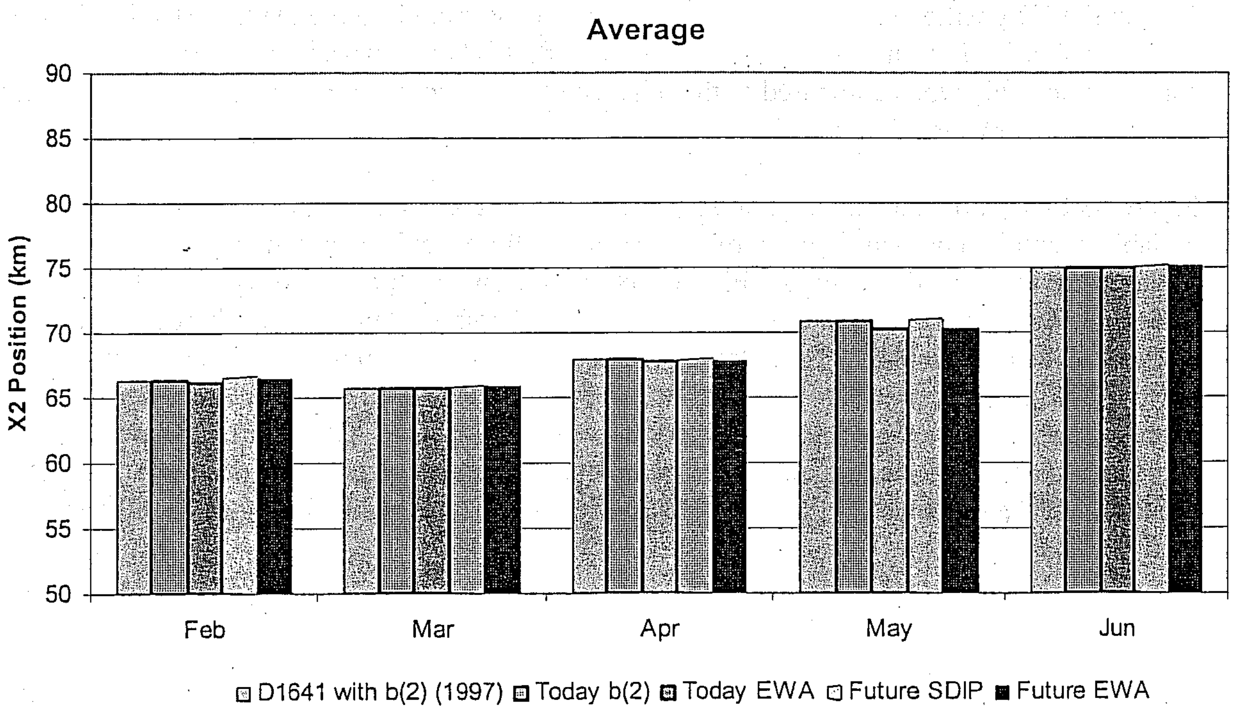


Figure 57 Average Monthly X2 Position

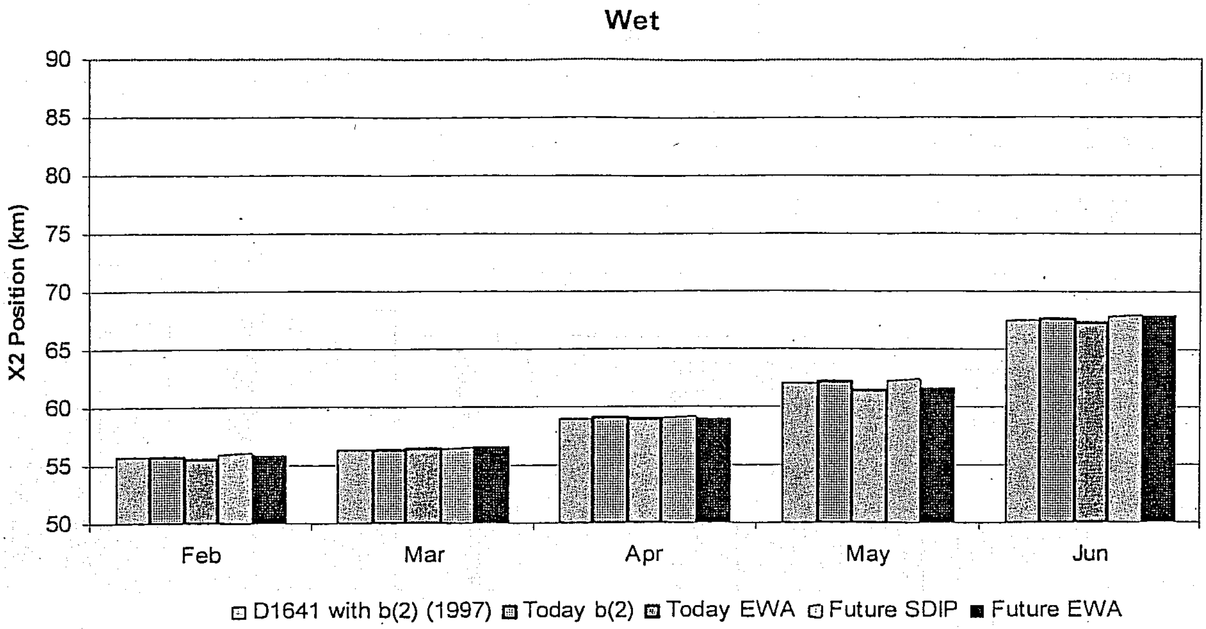


Figure 58 Average wet year (40-30-30 Classification) monthly X2 Position

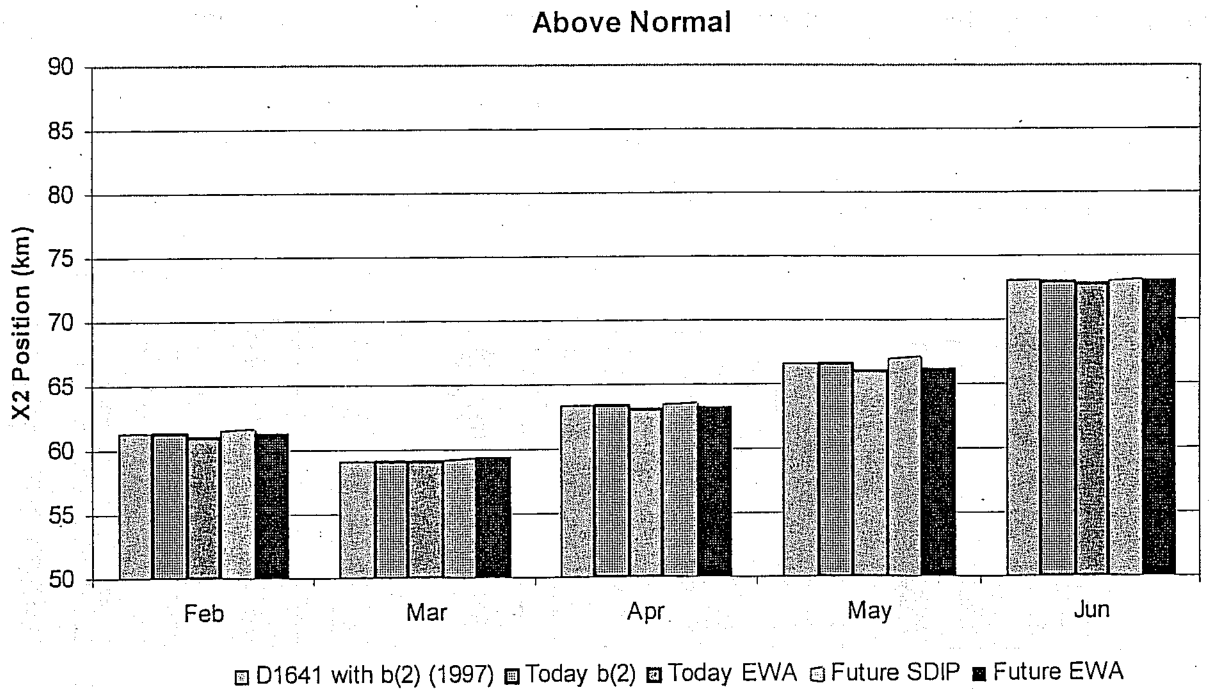


Figure 59 Average above normal year (40-30-30 Classification) monthly X2 Position

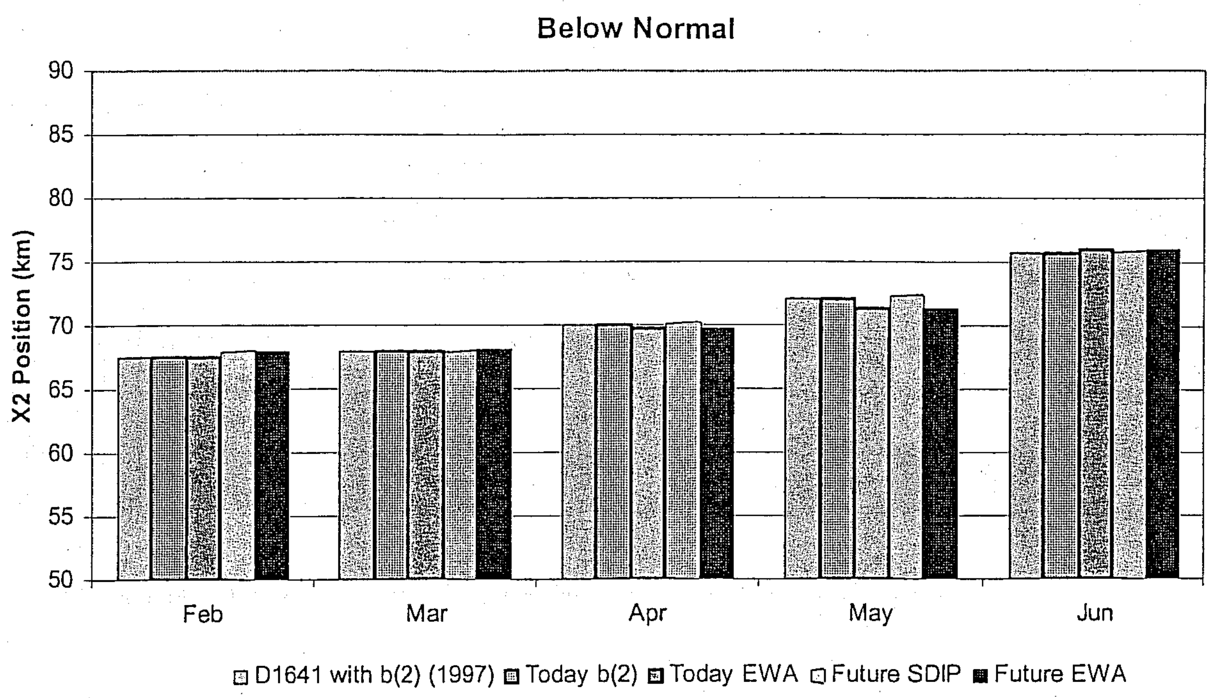


Figure 60 Average below normal year (40-30-30 Classification) monthly X2 Position

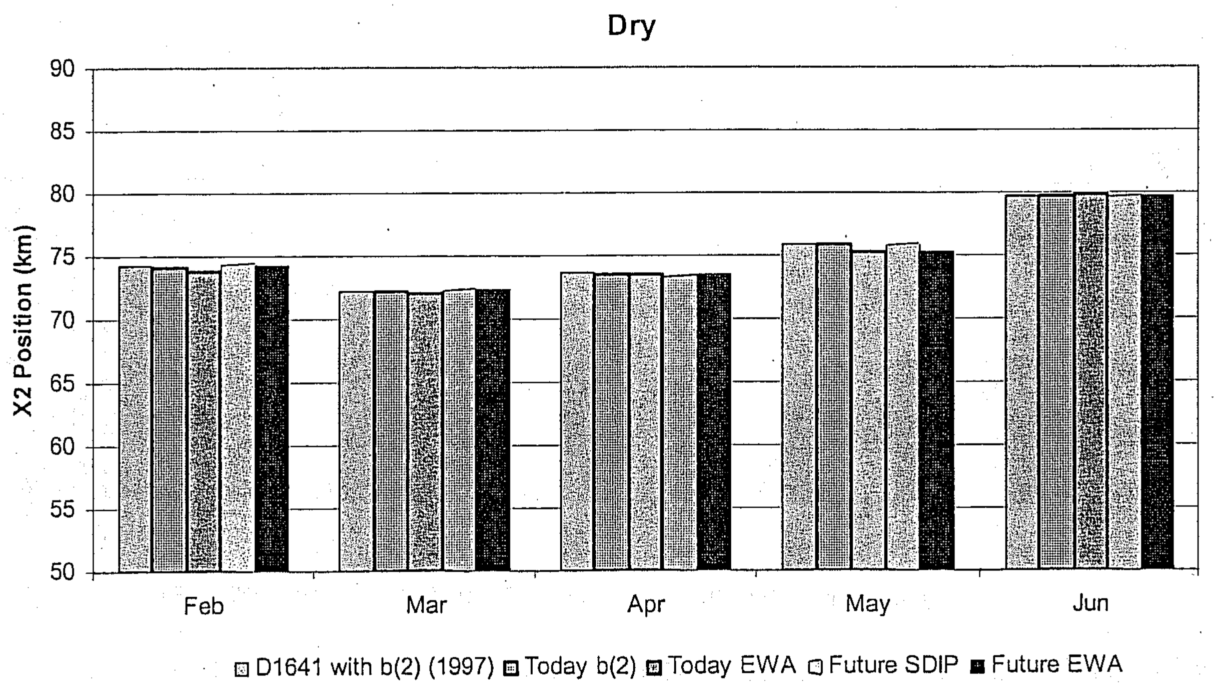


Figure 61 Average dry year (40-30-30 Classification) monthly X2 Position

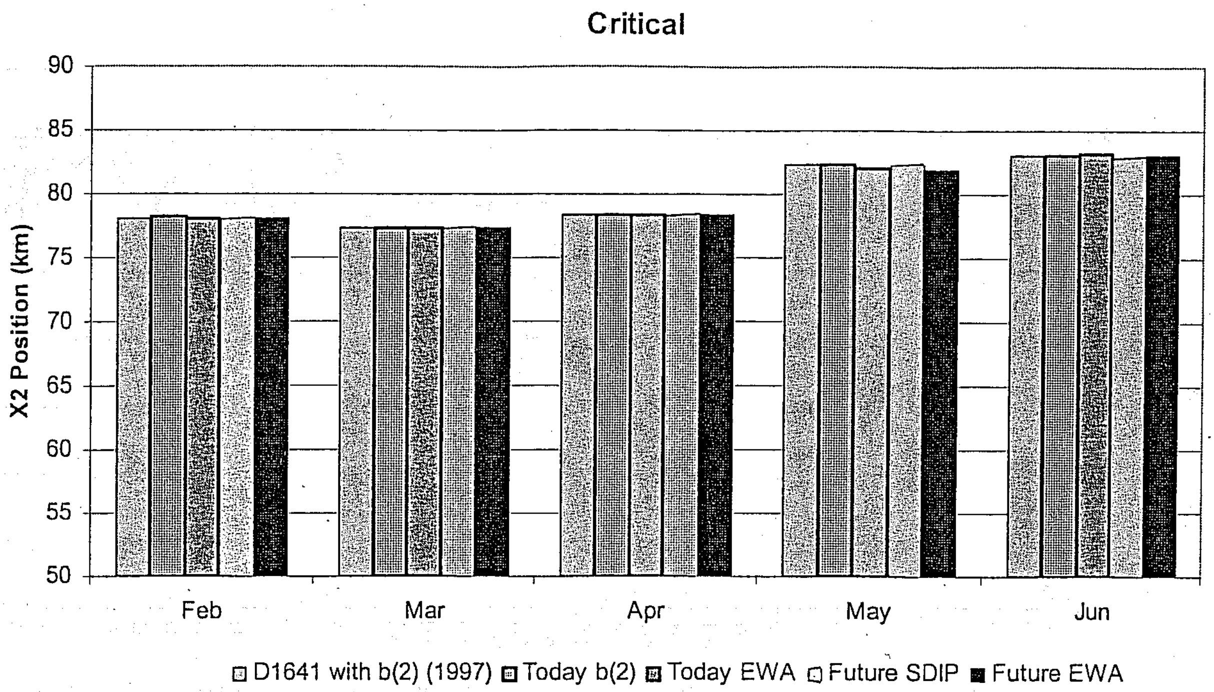


Figure 62 Average critical year (40-30-30 Classification) monthly X2 Position

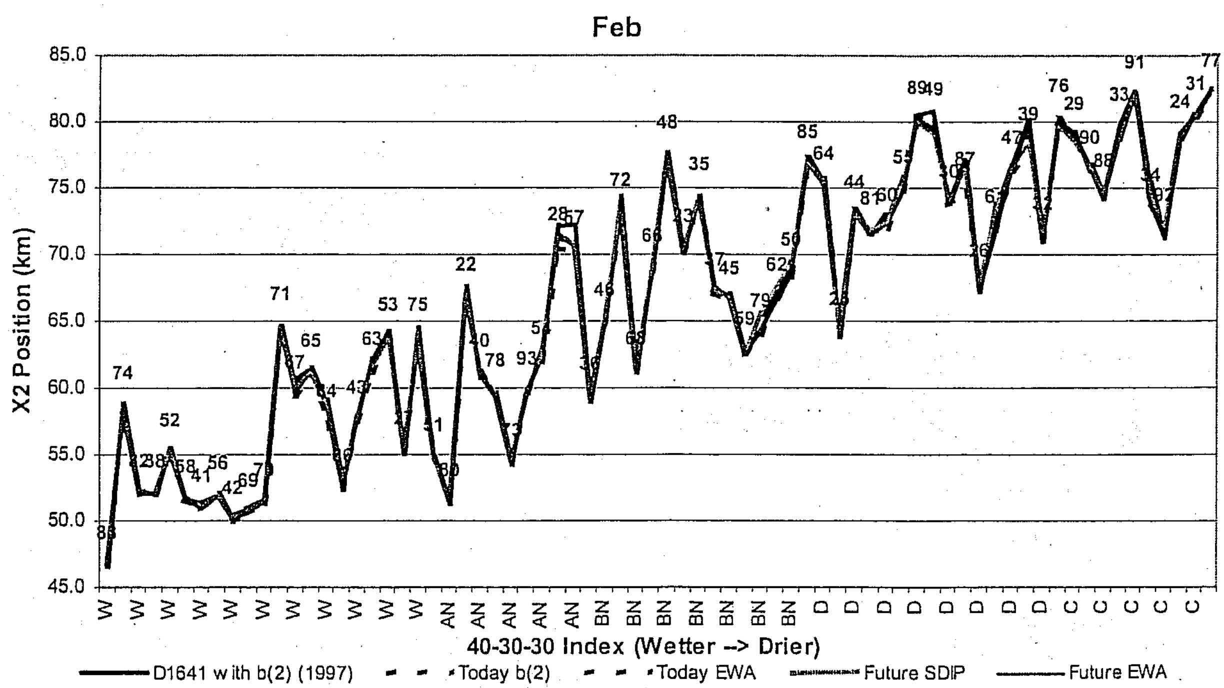


Figure 63 February X2 Position sorted by 40-30-30 Index

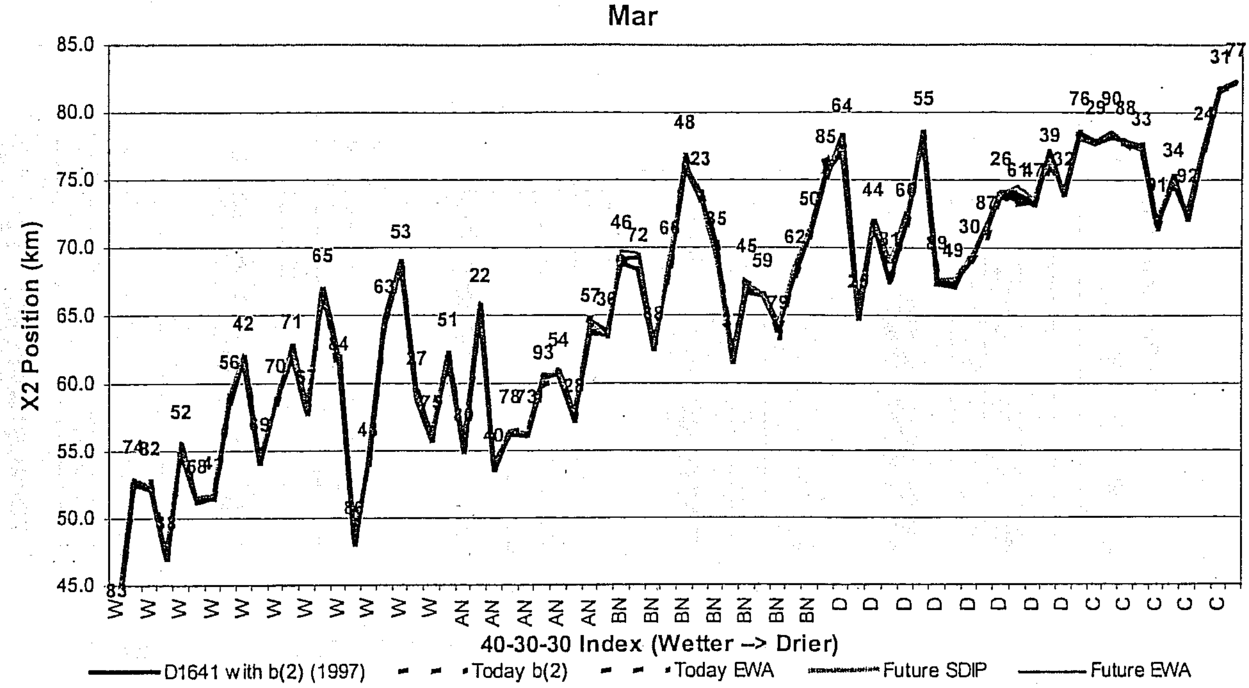


Figure 64 March X2 Position sorted by 40-30-30 Index

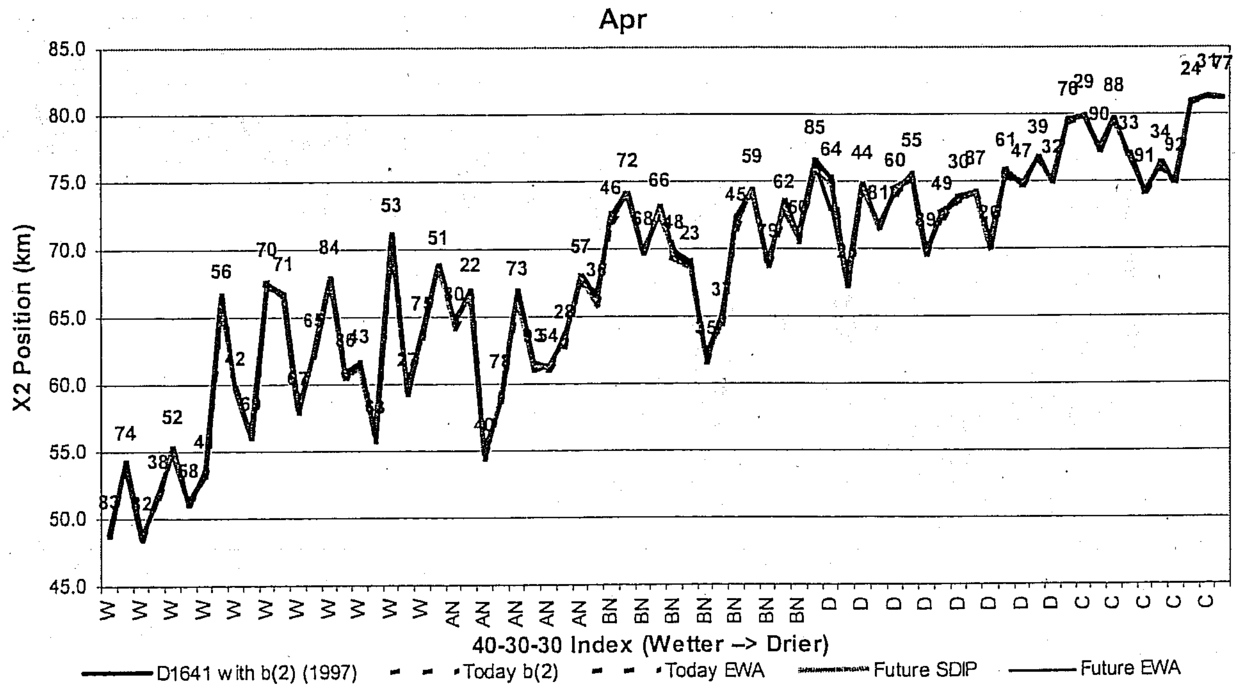


Figure 65 April X2 Position sorted by 40-30-30 Index

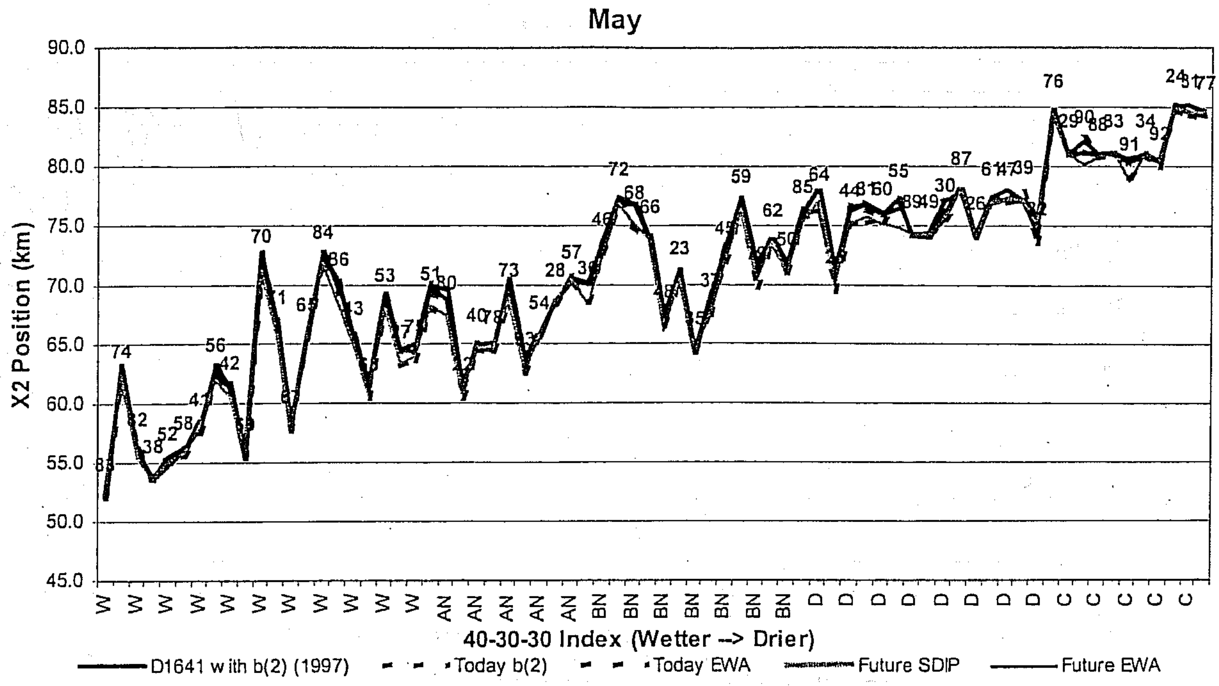


Figure 66 May X2 Position sorted by 40-30-30 Index

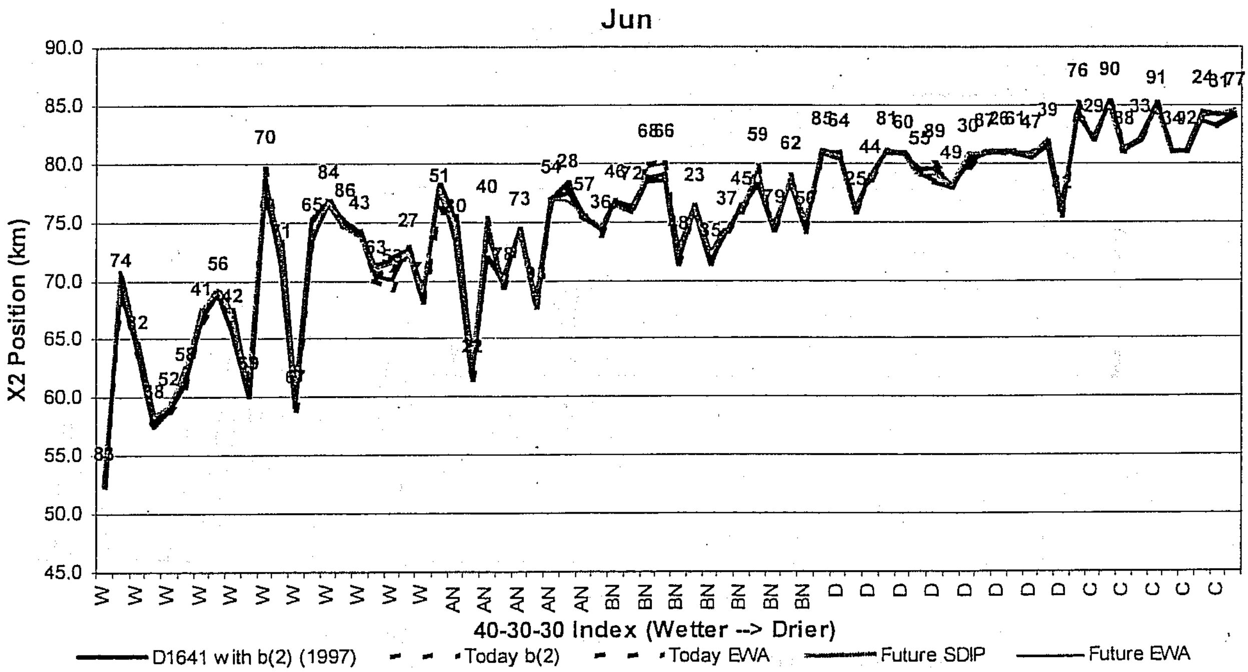


Figure 67 June X2 Position sorted by 40-30-30 Index

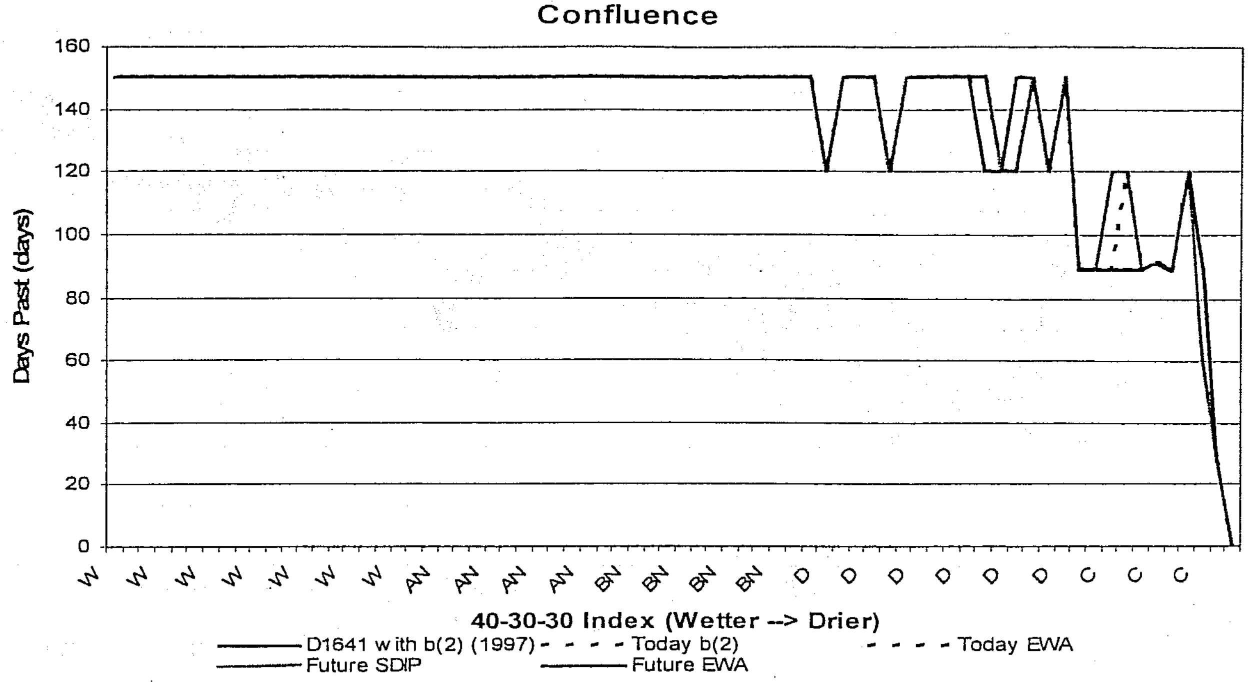


Figure 68 Total number of days average monthly X2 position is past the Confluence 40-30-30 Index (Note: that the total days for a month are assigned if the average X2 position is past the confluence)

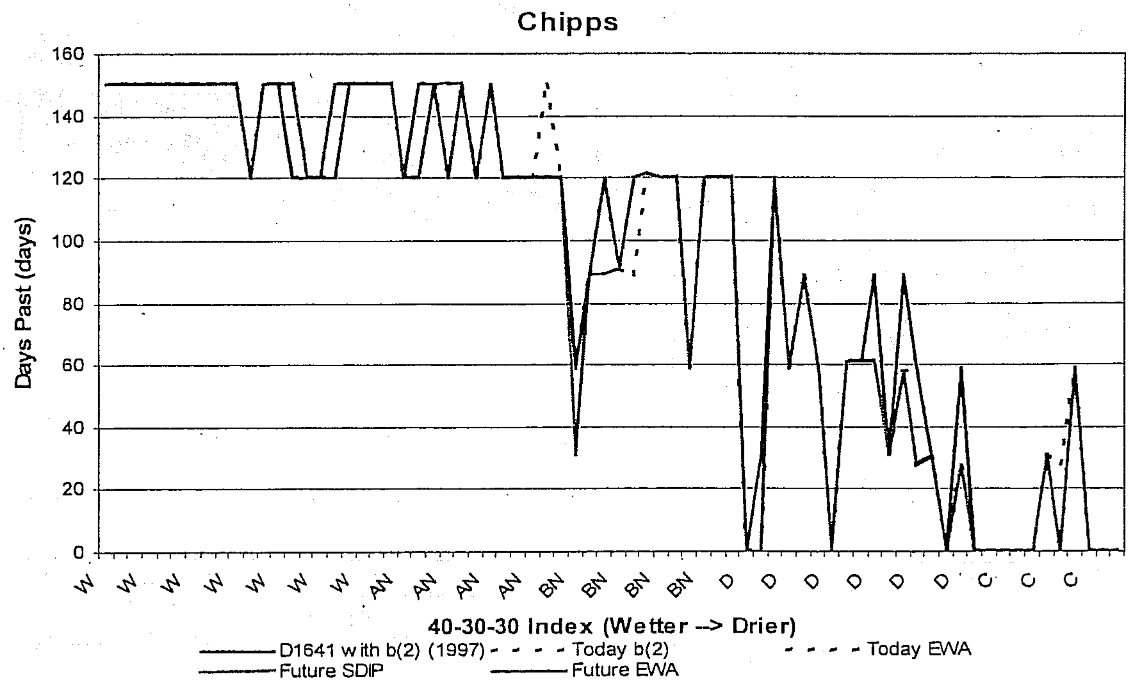


Figure 69 Total number of days average monthly X2 position is past the Chipps Island 40-30-30 Index (Note: that the total days for a month are assigned if the average X2 position is past the Chipps Island)

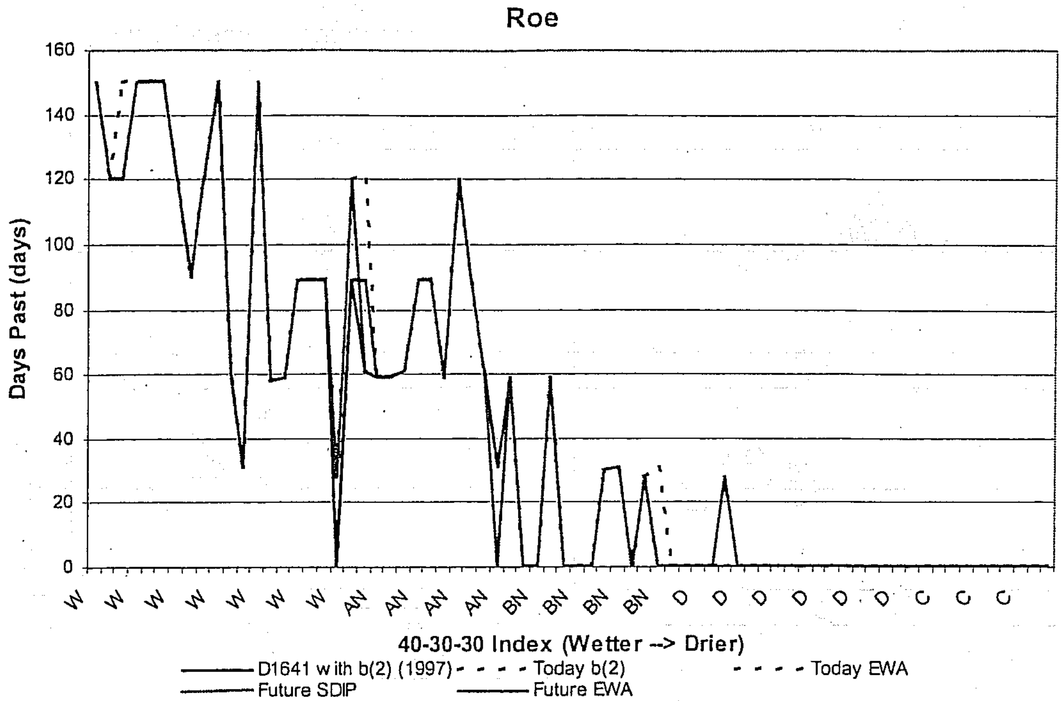


Figure 70 Total number of days average monthly X2 position is past the Roe Island 40-30-30 Index
(Note: that the total days for a month are assigned if the average X2 position is past the Roe Island)

Changes in Habitat Availability for Delta Smelt Based on X2 Movement

Another analysis using CALSIM II results looked at changes in X2 by water year and month. The average position of X2 during March–July of each year differed very little between model Study #1 and either #4 or #5 (refer to Table 10 for the Study descriptions). Concern arises with regard to upstream movements of X2 during the spring and early summer primarily because smelt tend to aggregate in a region defined by low salinity, and movement of that region upstream moves those aggregations closer to the export pumps. Upstream movements of X2 can cause smelt to become more susceptible to entrainment in the south Delta (March-July) and expose them to potentially lethal water temperatures (June-July). Because there is no basis for identifying a particular value as the critical one that separates a detrimental X2 difference from an innocuous one, one kilometer was selected as the criterion for review.

The difference between X2 in CALSIM II Studies #4 and #5 and Study #1 were plotted against X2 in Study #1 for each of the months March through July (Figures 71 to 75). In each figure, five panels representing each of the Sacramento River water-year types are presented. Positive differences represent movement of X2 upstream. In each figure, difference values larger than one kilometer in Below Normal, Dry, and Critically Dry years have been labeled with the years they represent.

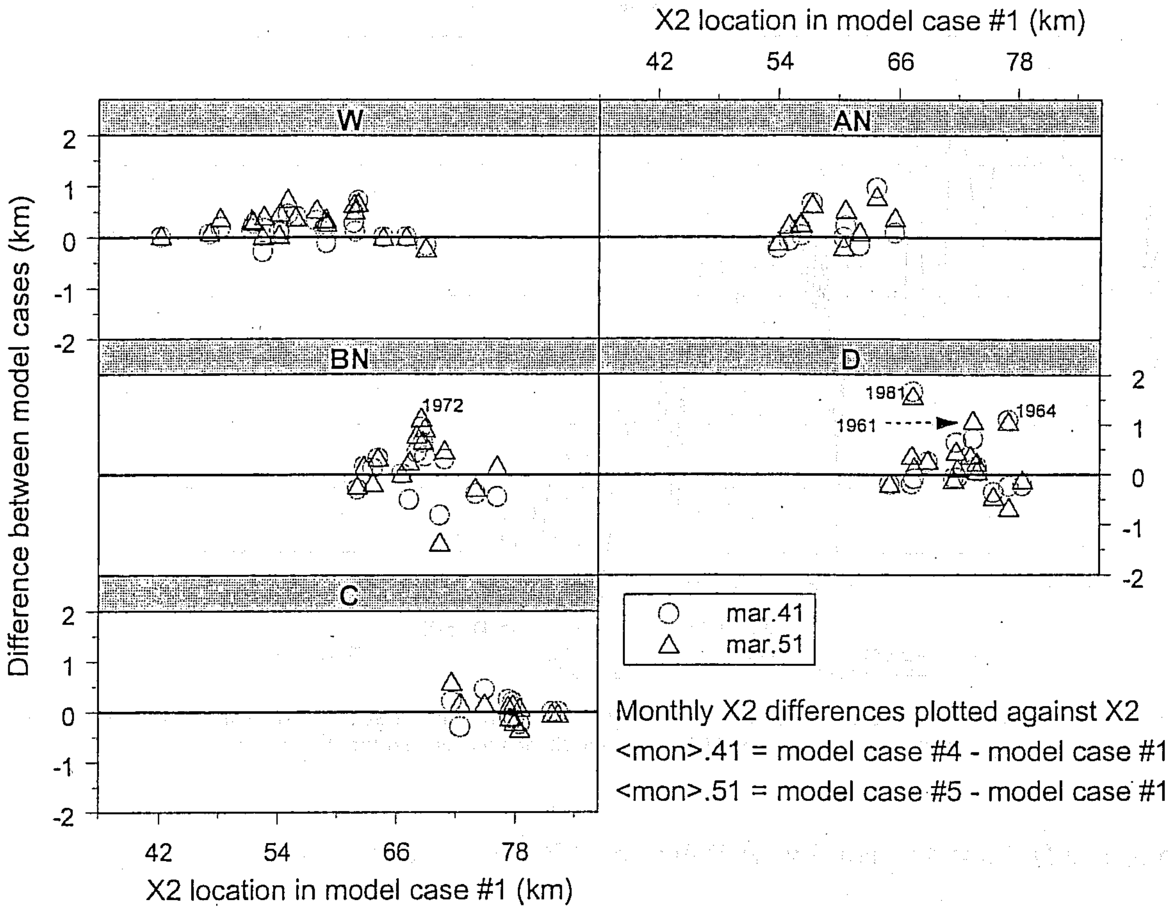


Figure 71 Differences in X2 under Studies #4 and #5 in March. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

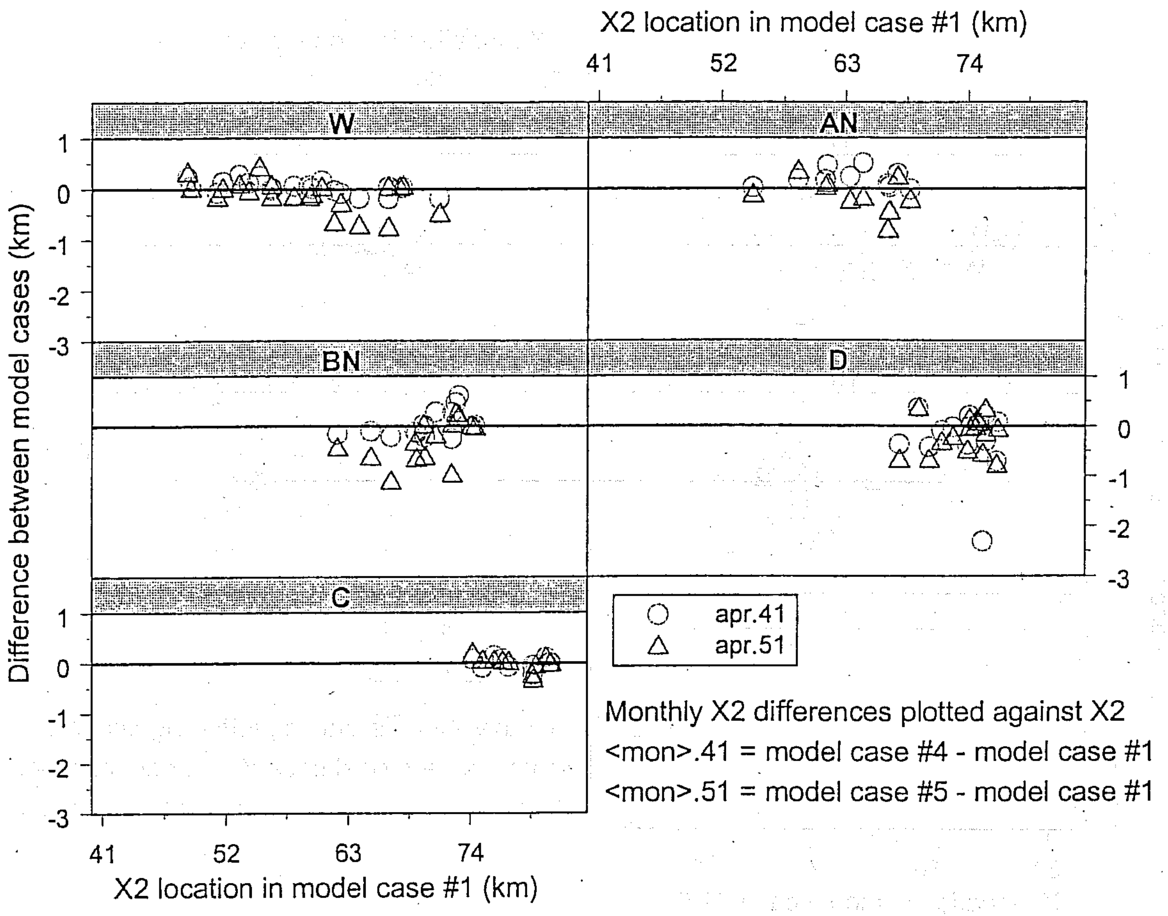


Figure 72 Differences in X2 under Studies #4 and #5 in April. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

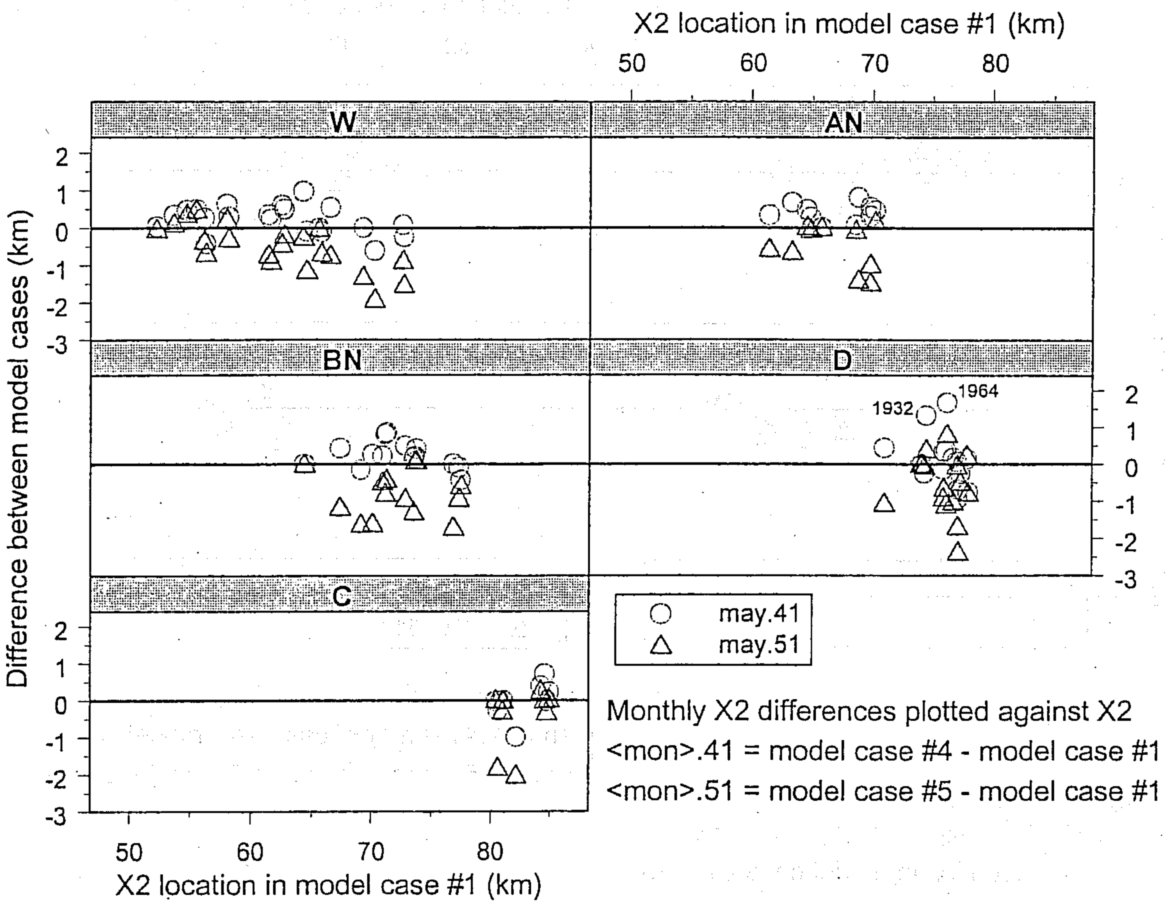


Figure 73 Differences in X2 under Studies #4 and #5 in May. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

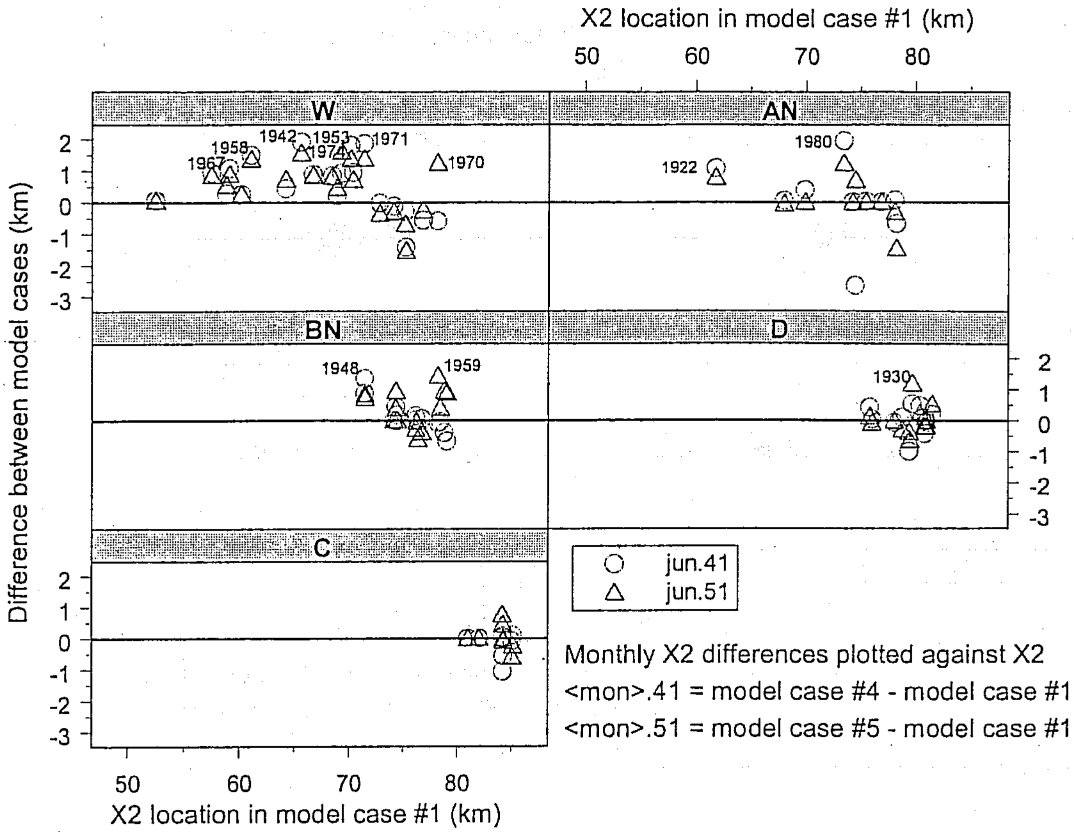


Figure 74 Differences in X2 under Studies #4 and #5 in June. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

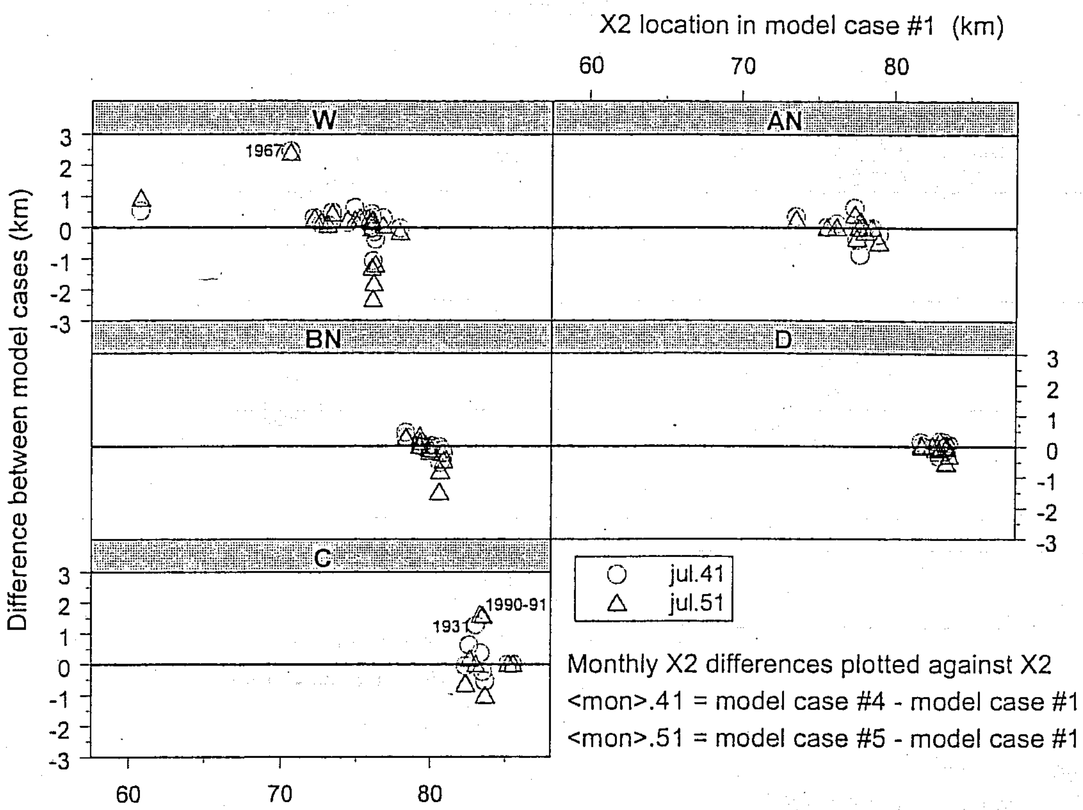


Figure 75 Differences in X2 under Studies #4 and #5 in July. Water year types: W=Wet, AN=Above Normal, BN=Below Normal, D=Dry, C=Critically Dry

Results

<u>March</u>

There was one detectable difference of at least one kilometer in in two Dry years (1964: 1.1 km; 1981: 1.7 km). In Study #5 it was achieved in three Dry years (1961: 1.1 km; 1964: 1.0 km; 1981: 1.6 km), and one Below Normal Year (1972: 1.1 km). None of these larger differences was followed by an April X2 difference larger than 0.34 km; indeed, all but two of the April differences were downstream movements and another was zero. It did not appear that X2 passed Chipps Island in any of these examples.

<u>April</u>

There were no detectable differences larger than one kilometer in April.

<u>May</u>

Study #4 during May in Dry years (1932: 1.3 km; 1964: 1.7 km). In both Studies (1932 and 1964), the differences were greatly reduced (1.3 km vs. 0.4 km in 1932 and 1.67 vs. 0.8 km in 1964) by the addition of EWA actions in model Study #5, resulting in Study #5 not reaching the criterion in any month. In the 1932 Study there was an upstream movement (0.4 km) in the following month, while in the 1964 Study there was a downstream movement (-0.4 km) in June. In the 1932 Study, X2 moved past Chipps Island (from 74.5 km in Study #1 to 75.8 km in Study #4).

June
In Study #4 X2 moved upstream one kilometer five times in Wet years (1942: 1.9 km; 1953: 1.8 km; 1958: 1.5 km; 1967: 1.1 km; 1971: 1.9 km), twice in Above Normal years (1922: 1.1 km; 1980: 2.0 km), and once in a Below Normal year (1948: 1.3 km). In Study #5 X2 moved upstream one kilometer six times in Wet years (1942: 1.6 km; 1953: 1.4 km; 1958: 1.4 km; 1970: 1.2 km; 1971: 1.4 km; 1974: 1.6 km), once in an Above Normal year (1980: 1.2 km), once in a Below Normal year (1.4 km), and once in a Dry year (1930: 1.2 km). In all of these instances save 1967 in Study #4a the X2 difference in the following month was much smaller or moved downstream. None of these Studies appears to involve a movement of X2 past Chipps Island.

July
In Study #4 X2 moved upstream more than 1 km once in a Wet year (1967: 2.5 km) and once in a Critically Dry year (1931: 1.3 km). In #5 X2 moved upstream more than 1 km in 1967 (2.4 km) and twice in Critically Dry years (1990: 1.6 km; 1991: 1.6 km). In all Studies except #4 in 1967, there was a downstream shift from Study #1 in the following month. None of these Studies involved a shift of X2 east past Chipps Island.

Modeling Summary
Upstream movements of X2 predicted in the future Studies reach one kilometer or more only occasionally. In some Studies upstream movements observed in Study #4 were reduced or erased in Study #5. In a few Studies the upstream movement is larger in Studies #5 and #5a. There were a few movements from the west to the east side of Chipps Island, but these were of small magnitude.

CH2MHill Analysis
The CH2MHill analysis, as shown in Appendix L of the BA compared the location of X2 for February through June for the future Study as compared to the base Study (study 5A vs. study 1). The monthly X2 location was taken from the CALSIM II modeling studies. X2 locations from study 5A and study 1 were then mapped (see Figure 32 for an example) to show how far X2 moved upstream. In wet years, X2 is located in Suisun Bay throughout the modeled period. An upstream movement of 0.5 km in wet years would not significantly reduce habitat quality or quantity for delta smelt. In drier years, X2 is located upstream of the confluence of the Sacramento and San Joaquin Rivers and the amount of quality habitat available to delta smelt is minimal and adult abundance is low (Bennett 2003). When X2 is located this far upstream, smelt would already be susceptible to increased mortality due to high temperatures, predation and entrainment. An upstream movement of X2 of 0.5 km would not be significant when it is located upstream of the confluence because delta smelt habitat is already poor and the upstream movement does not result in any substantial additional loss of habitat or increase in adverse effects. This analysis showed that there were 37 months (out of a possible 360 months) where X2 moved upstream more than 0.5 km. By ruling out the wet and dry years described above, the Service determined that there were 6 months out of the 37 months where the upstream movement

of X2 could result in a substantial loss of habitat for delta smelt.

Therefore, in order to protect smelt from detrimental effects when X2 is upstream of Chipps Island, the DSRAM will be used to determine whether actions are necessary to protect delta smelt. The DSRAM and a description of it is located in Appendix A. The DSRAM has a number of triggers that determine when the Delta Smelt Working Group meets. One of the triggers calls for the Delta Smelt Working Group to meet if X2 is upstream of Chipps Island and temperatures are between 12 and 18 degrees Celsius, the approximate range of spawning temperatures for delta smelt. If this trigger is met, the Working Group will meet to evaluate whether to a change in operations such as a change in exports, San Joaquin River flows, barrier operations or cross channel gates might help protect smelt. The Working Group's recommendation will then be sent to the WOMT for consideration of implementation. Through these actions, potentially detrimental effects to delta smelt due to an upstream movement of X2 will be avoided or ameliorated.

Pumping at the CVP and SWP Facilities

Tracy Pumping

The Tracy Pumping Plant in Studies 4 and 5 the intertie allows pumping to increase to the facility design capacity of 4600 cfs (from its current pumping rate of 4200 cfs). Figure 76 shows the percentile values for monthly pumping at Tracy. November through February are the months when Tracy most frequently pumps at 4600 cfs. Tracy can better utilitze the 4600 cfs pumping in wet years in Study 4 and Study 5 (Figure 78).

From Figure 76, the pumping is decreased in December through February in Studies 3 and 5 by the 25 TAF/month placeholder for the EWA program. April, May and June show reductions compared to other months because of the VAMP restrictions, and May shows further reductions due to EWA spending some assets to implement the May Shoulder pumping redcution. July through September show pumping increases generally for irrigation deliveries.

Figures 77 to 82 show similar trends in monthly average exports by year type with pumping being greatest December through February and July through September. The exception is in the Critical year (Figure 82) when the pumping stays between 1000 cfs and 1500 cfs through August due to reduced storage and water qaulity (salinity) in the Delta. In general, pumping at Tracy will increase in Study 5a and may increase the number of delta smelt entrained, but these increases in entrainment are likely to be avoided by the DSRAM and use of EWA water to reduce exports.

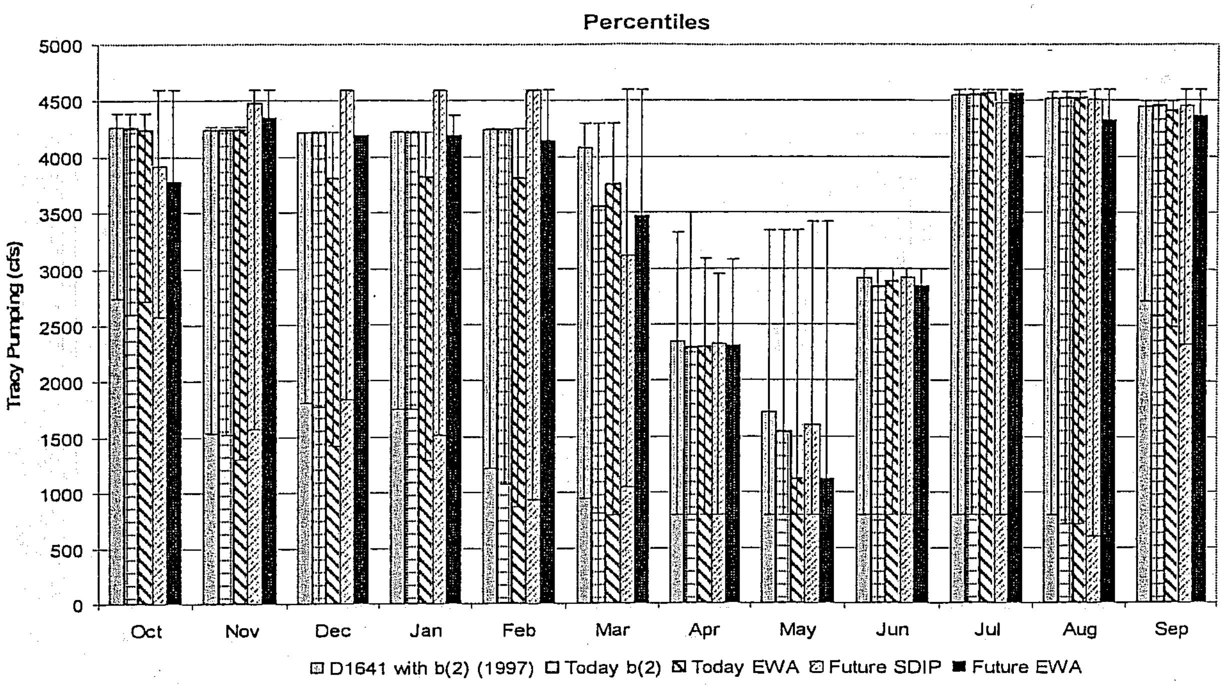


Figure 76 Tracy Pumping 50th Percentile Monthly Releases with the 5th and 95th as the bars

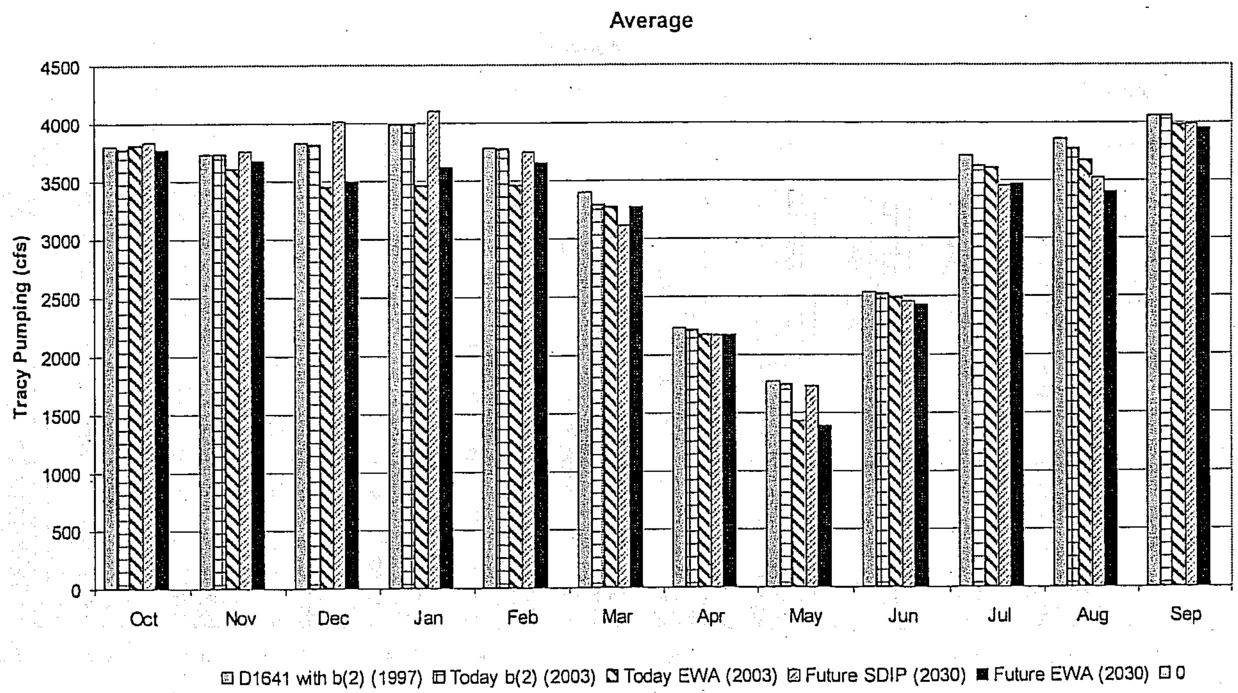


Figure 77 Average Monthly Tracy Pumping

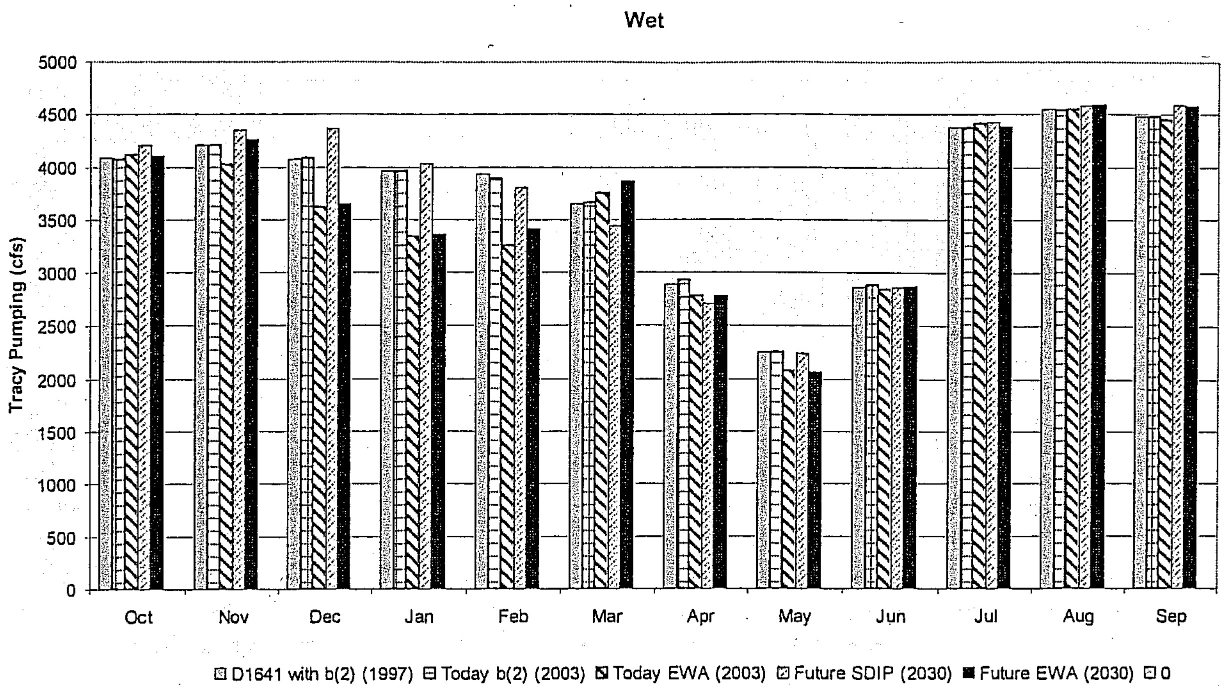


Figure 78 Average wet year (40-30-30 Classification) monthly Tracy Pumping

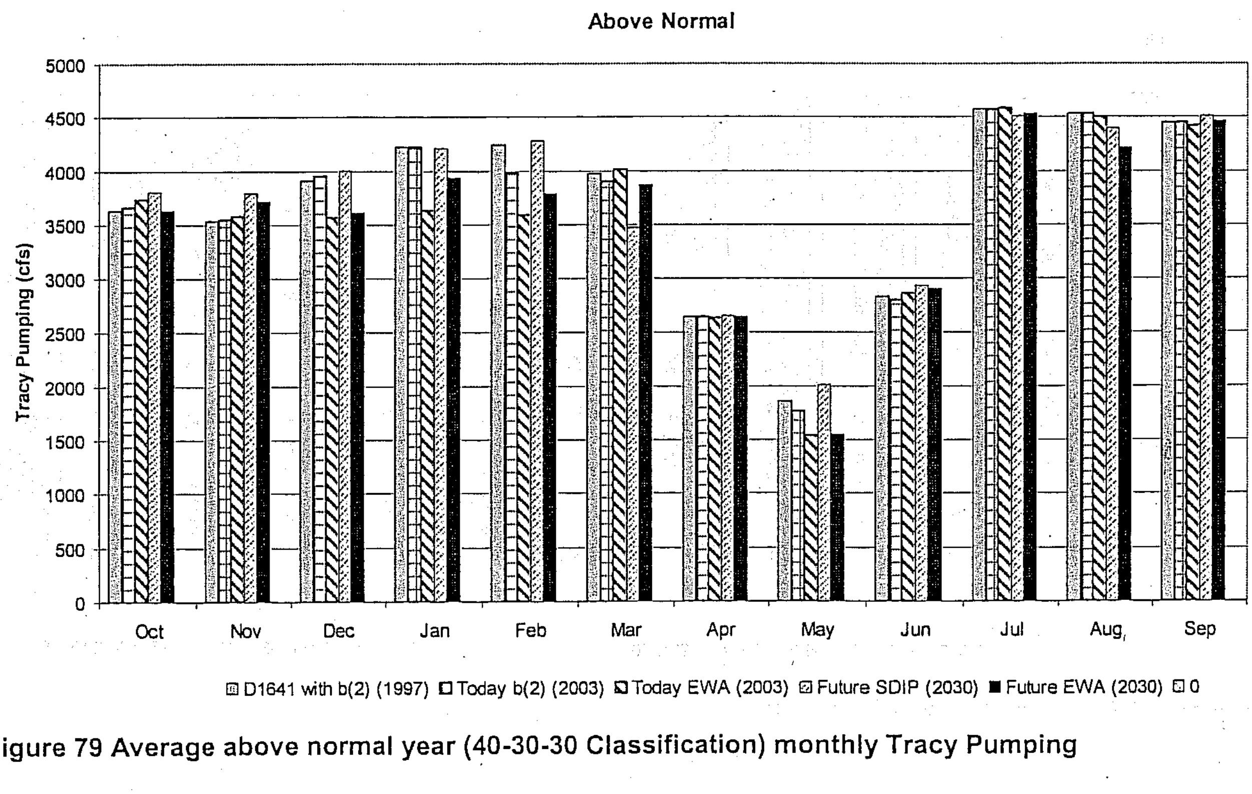


Figure 79 Average above normal year (40-30-30 Classification) monthly Tracy Pumping

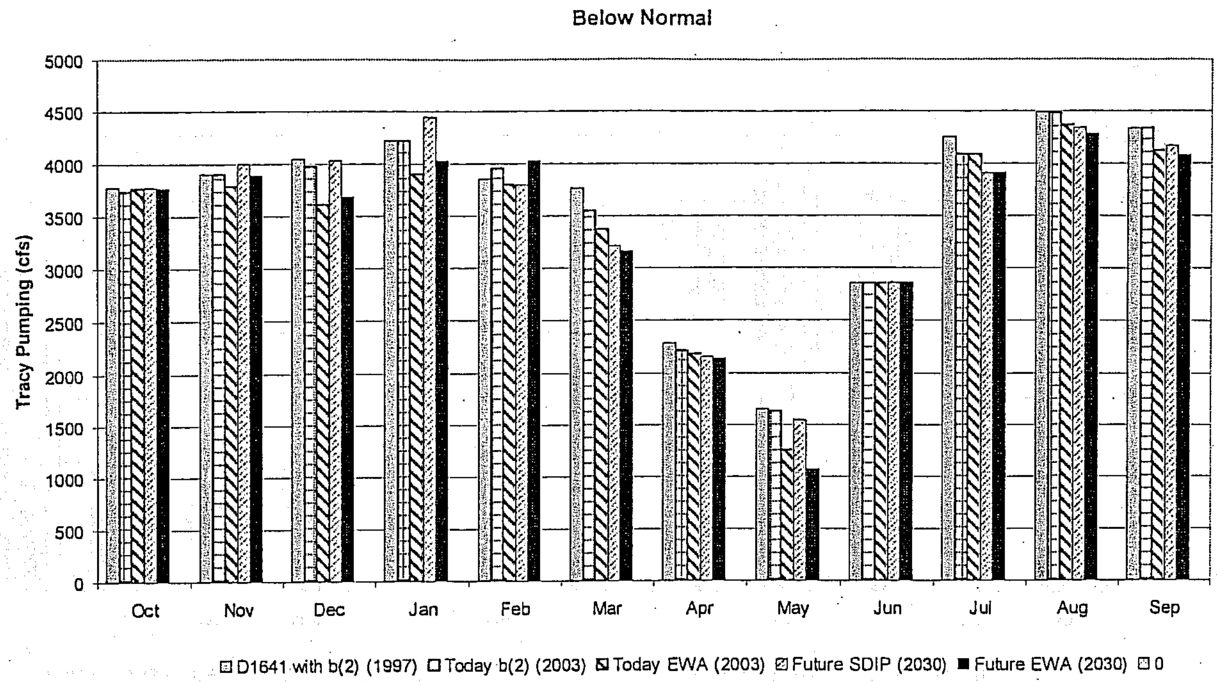


Figure 80 Average below normal year (40-30-30 Classification) monthly Tracy Pumping

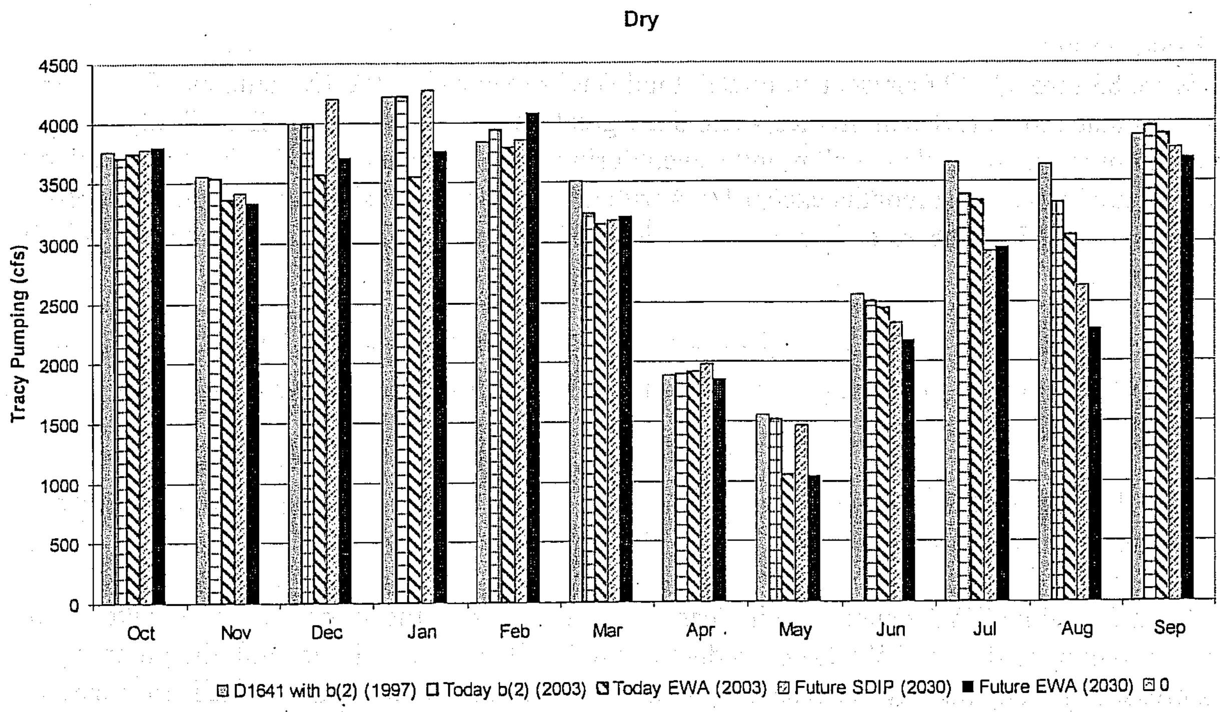


Figure 81 Average dry year (40-30-30 Classification) monthly Tracy Pumping

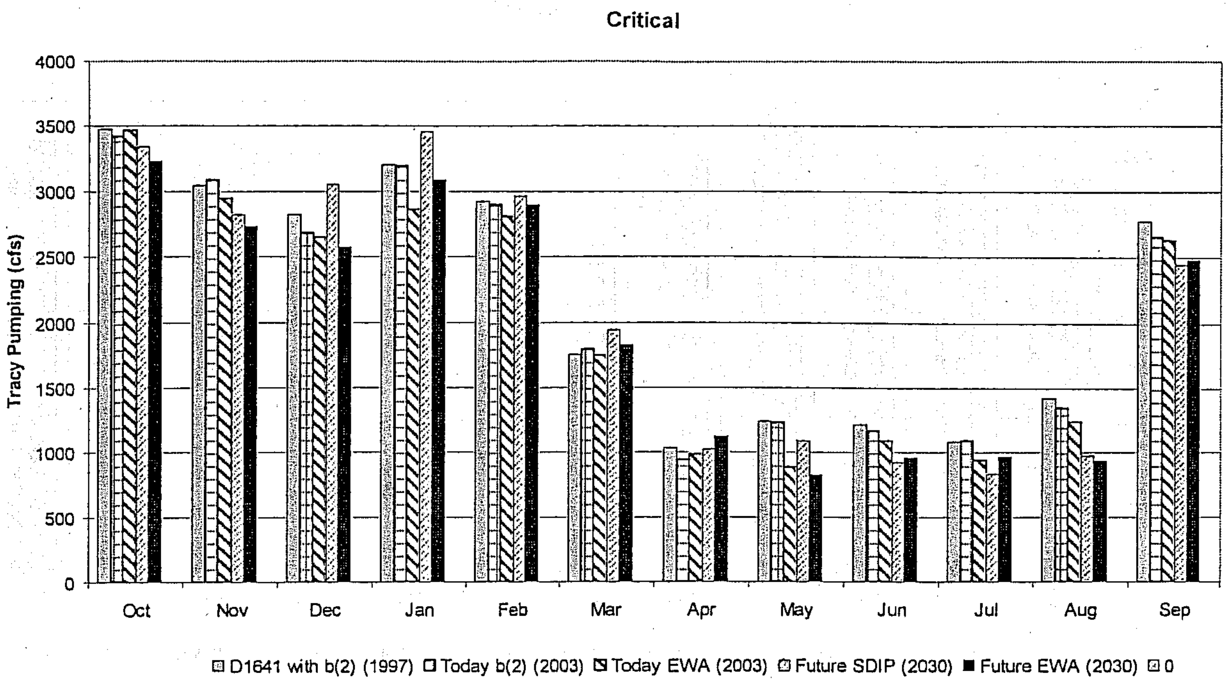


Figure 82 Average critical year (40-30-30 Classification) monthly Tracy Pumping

Banks Pumping
Figure 83 through 89 represent simulated total Banks exports for the five studies. Figure 92 shows that export levels in Studies 4 and 5 are greater than Study 1. The SDIP Study shows higher pumping over almost all months even during the April-May period. The Future export levels are higher most months except for April and May. The whisker plot (Figure 83) also shows that a 8500 export level is reached at least 5% of the time in the SDIP and the EWA future Studies

While EWA and SDIP implementation in Study 5 results in higher export levels in all months except for April and May, the percentage of the summer time increases vary as a function of year type (Figure 84 to 89).

In the driest years EWA related exports more than double the July, August, and September exports when compared to Study 1.

Most of the time EWA exports are increased primarily during the summertime to make up for reduced exports due to EWA export reductions in April and May. In general, the pumping increases in Study 5a may increase the number of delta smelt entrained, but these increases in entrainment are likely to be avoided by the DSRAM and use of EWA water to reduce exports.

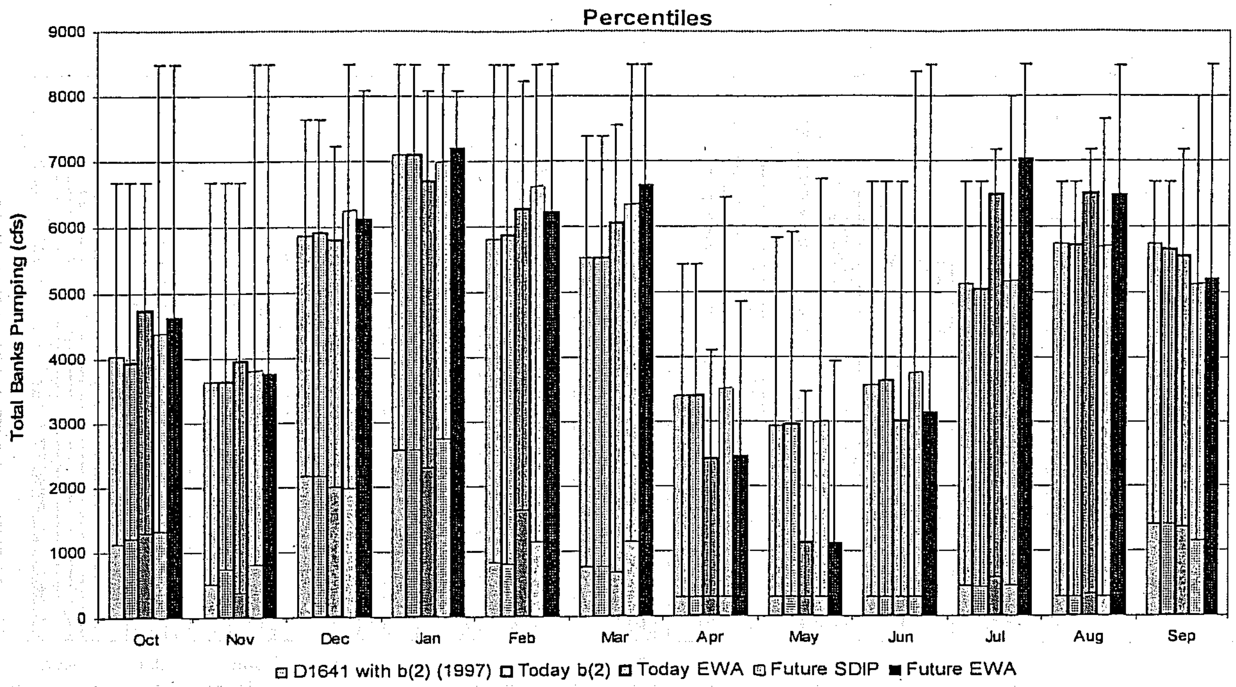


Figure 83 Banks Pumping 50th Percentile Monthly Releases with the 5th and 95th as the bars

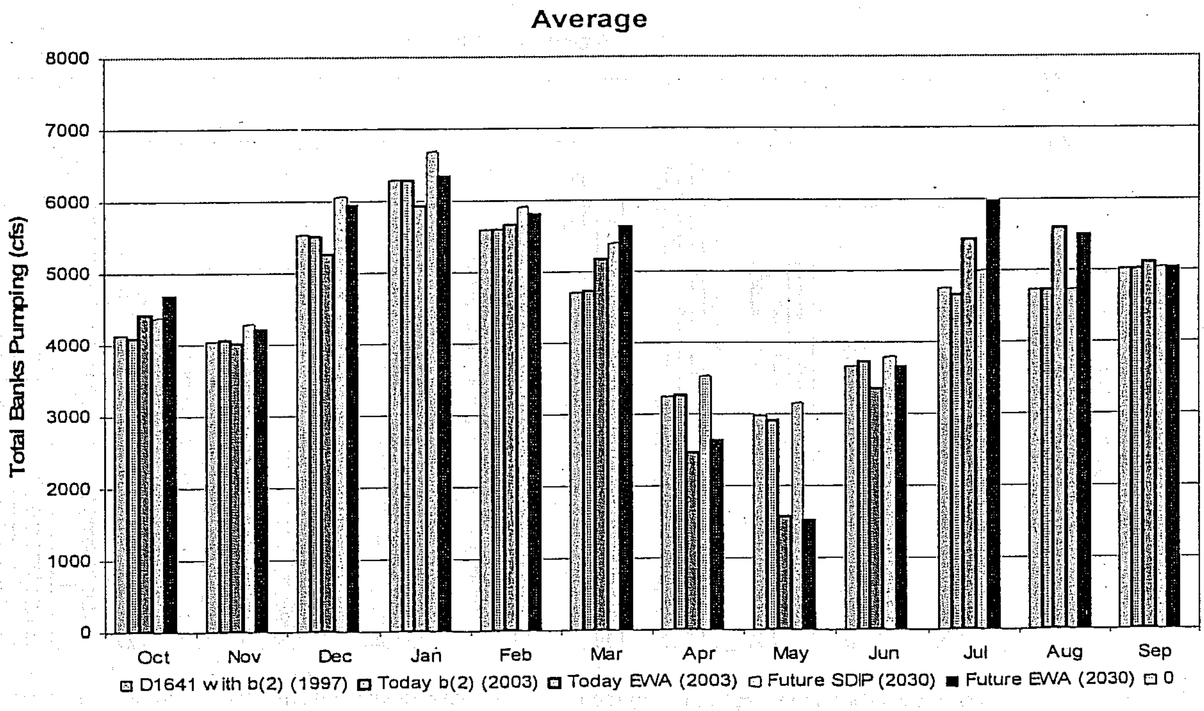


Figure 84 Average Monthly Banks Pumping

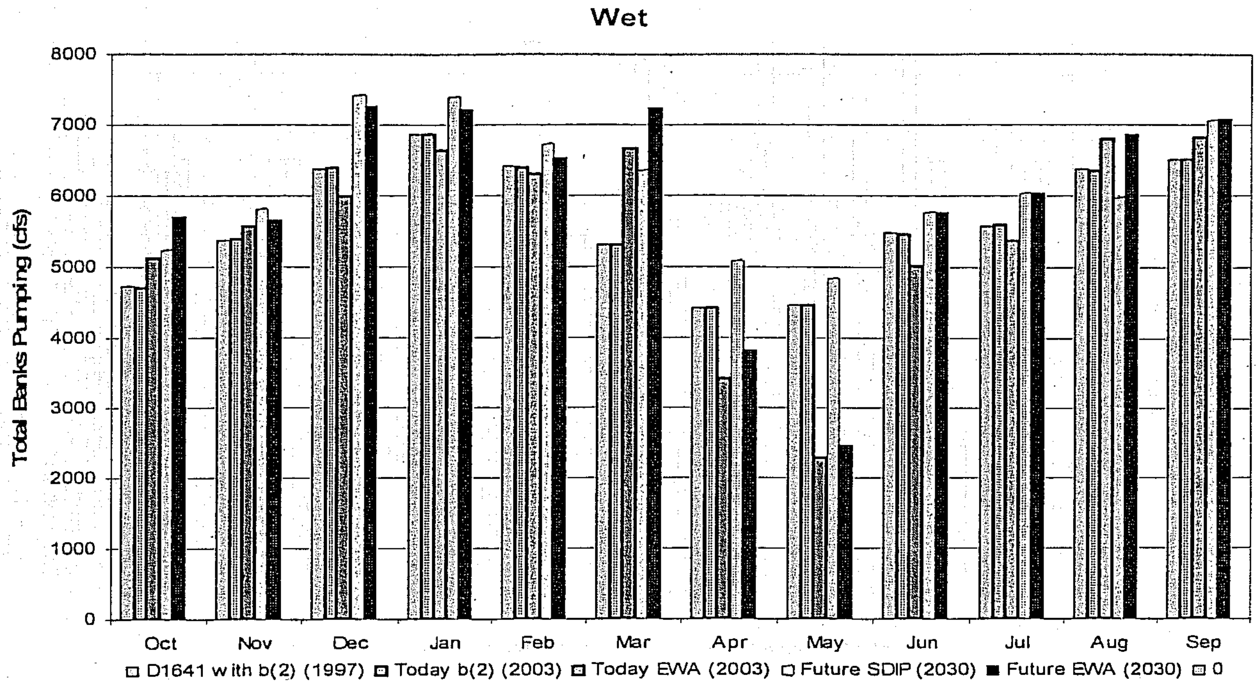


Figure 85 Average wet year (40-30-30 Classification) monthly Banks Pumping

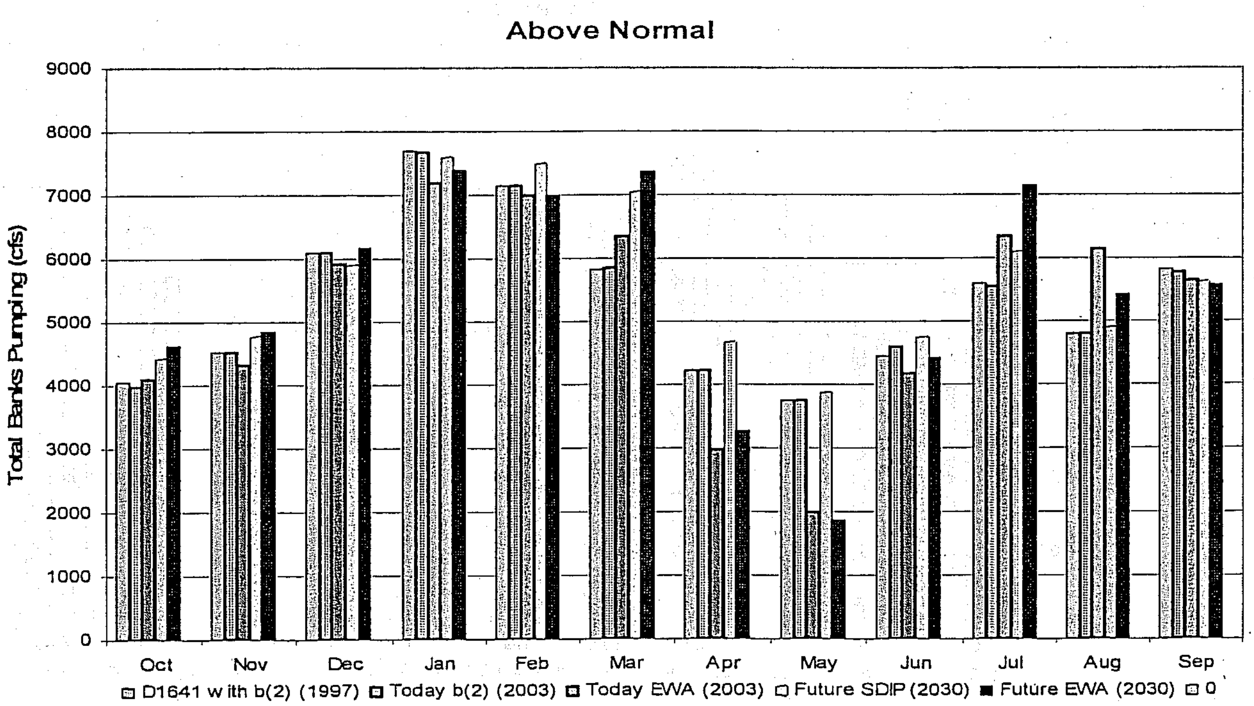


Figure 86 Average above normal year (40-30-30 Classification) monthly Banks Pumping

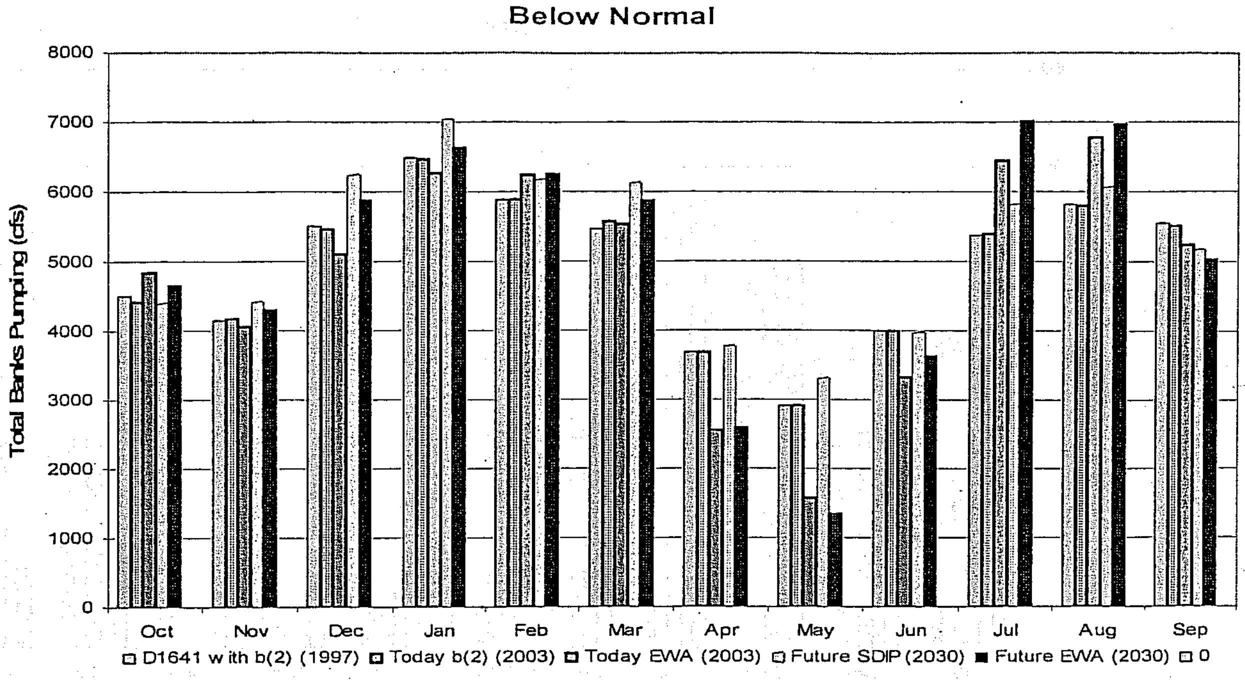


Figure 87 Average below normal year (40-30-30 Classification) monthly Banks Pumping

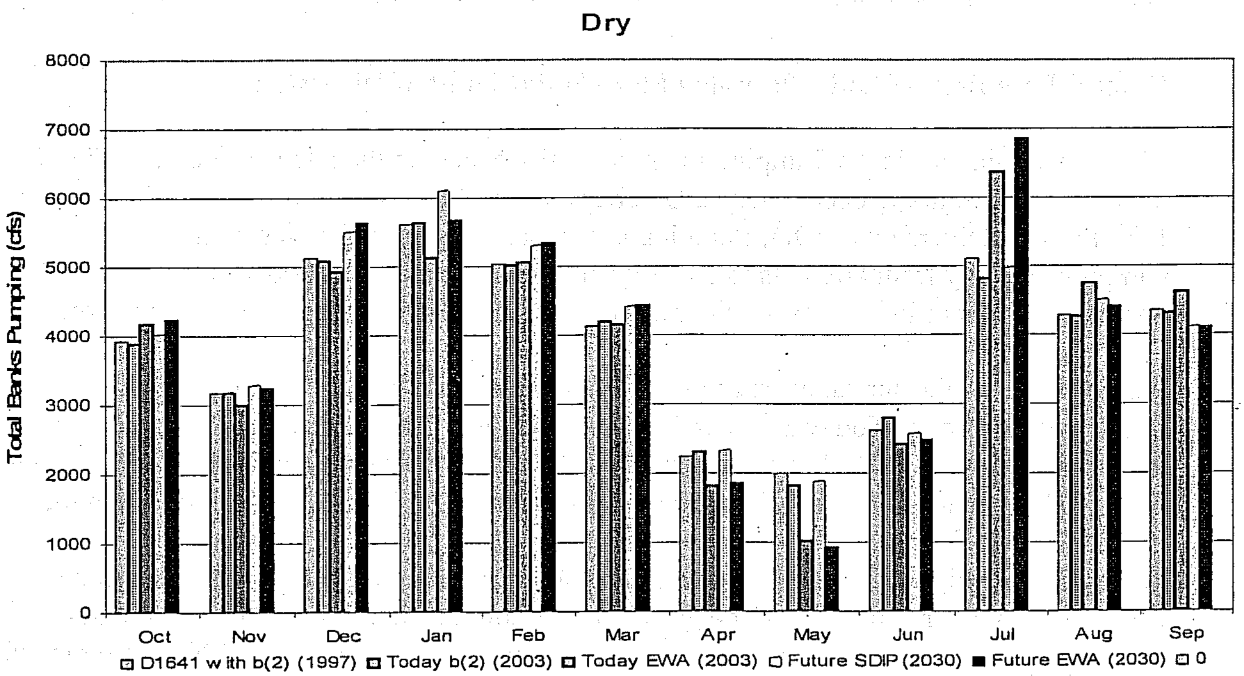


Figure 88 Average dry year (40-30-30 Classification) monthly Banks Pumping

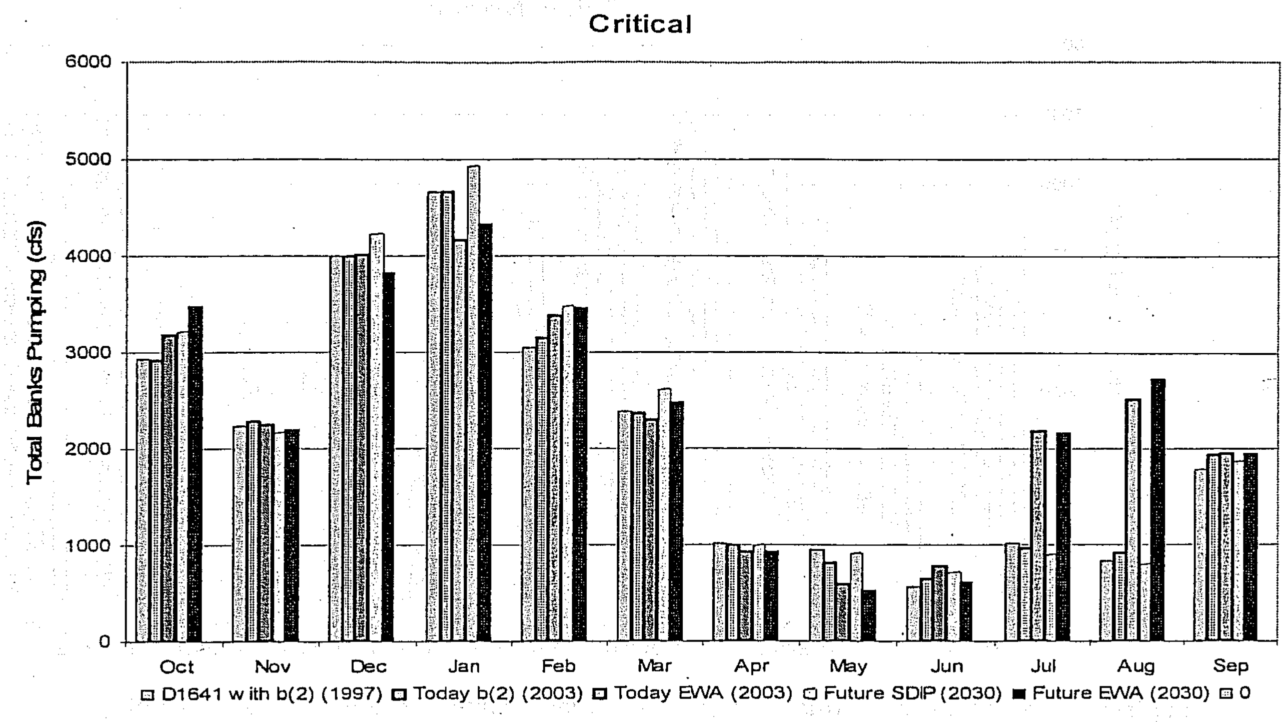


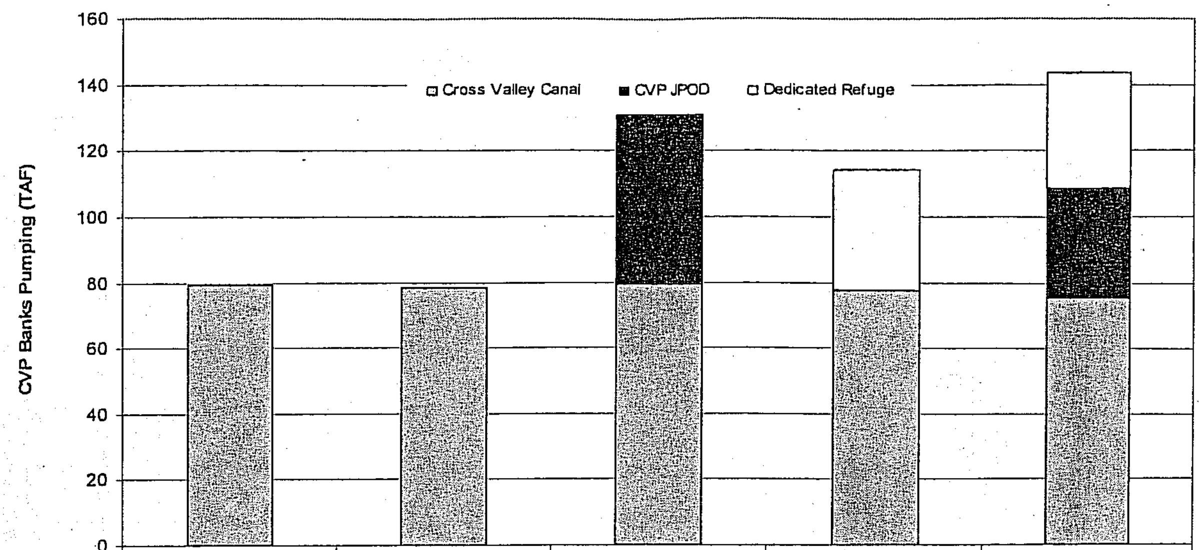
Figure 89 Average critical year (40-30-30 Classification) monthly Banks Pumping

Federal Pumping at Banks Pumping Plant (Joint Point of Diversion)

Federal pumping at Banks Pumping Plant generally occurs in the late summer, see Figure 91. Some Federal pumping occurs during October through March for Cross Valley Contractors. Joint Point of Diversion (JPOD) Pumping is generally higher in Studies 4 and 5 due to increased pumping capacity from 6680 cfs to 8500 cfs and the dedicated 100,000 af/Yr. Most JPOD opportunities occur in wet years, with pumping averages decreasing as the years get drier.

Figure 90 shows the annual average use of Banks pumping for the CVP by study. The average JPOD pumping in the Today EWA and Future EWA was 52 TAF and 33 TAF respectively. If the Future EWA JPOD includes the dedicated 100,000 af/yr the number is 68 TAF. Pumping for Cross Valley Canal (Tier 1 JPOD pumping) ranges from 75 TAF to 79 TAF between the studies.

These Figures (Figures 92 to 97) show that most JPOD pumping occurs in the summer and fall, when delta smelt are not likely to be present in the south Delta. Smelt entrainment at the export facilities is not likely to increase as a result of the JPOD pumping. Since JPOD pumping also benefits the EWA, it can be considered a beneficial action when smelt are not present in the south Delta. JPOD pumping will not occur until the Management Agencies (and the Working Group, as necessary) through the WOMT determine that fish in the Delta would not be harmed.



	D1641 with b(2)	Today b(2)	Today EWA	Future SDIP	Future EWA
Dedicated Refuge	0	0	0	37	35
CVP JPOD	0	0	52	0	33
Cross Valley Canal	79	78	79	78	75

Figure 90 Average use of Banks pumping for the CVP

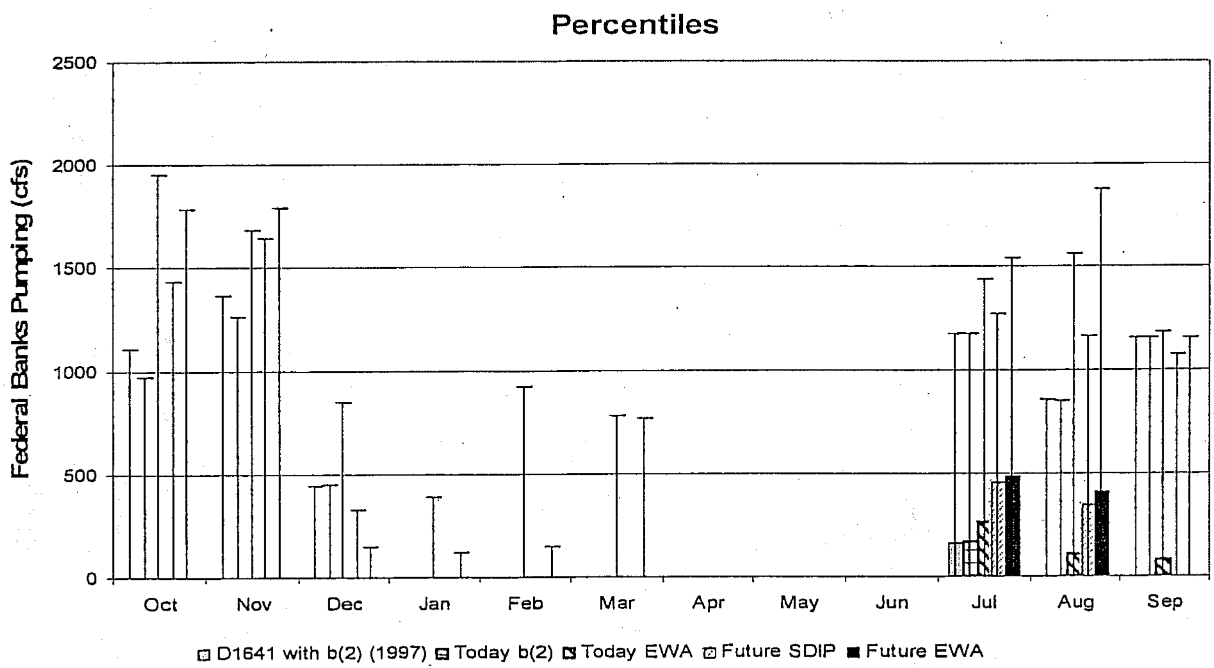


Figure 91 Federal Banks Pumping 50th Percentile Monthly Releases with the 5th and 95th as the bars

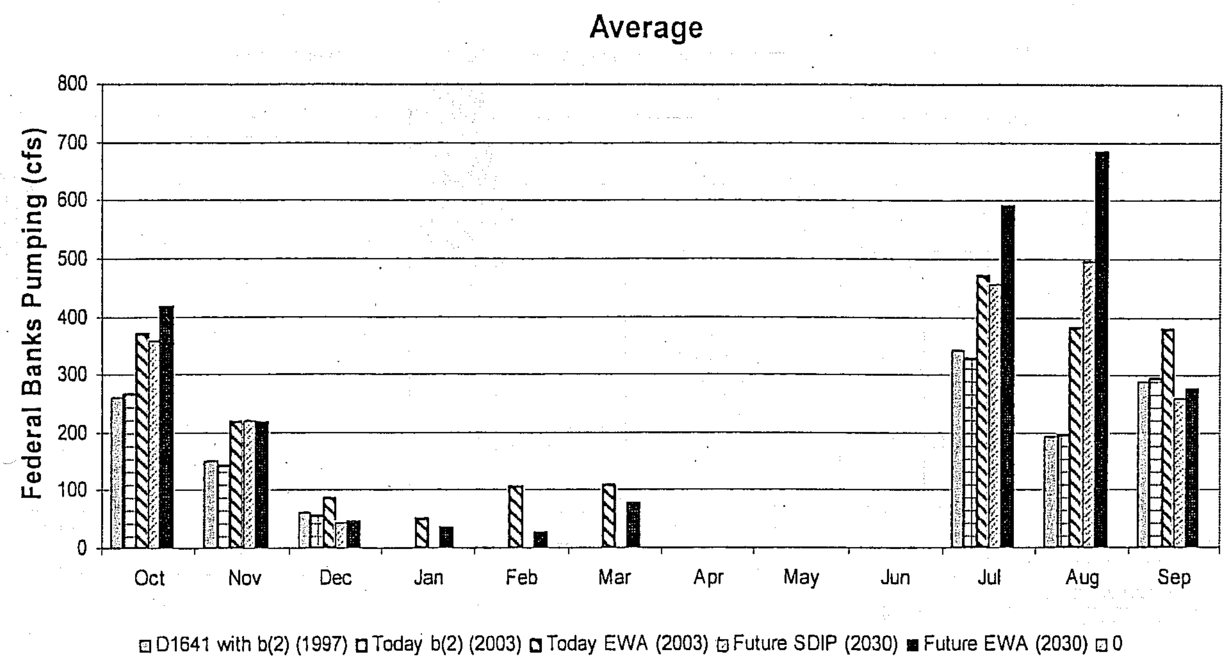


Figure 92 Average Monthly Federal Banks Pumping

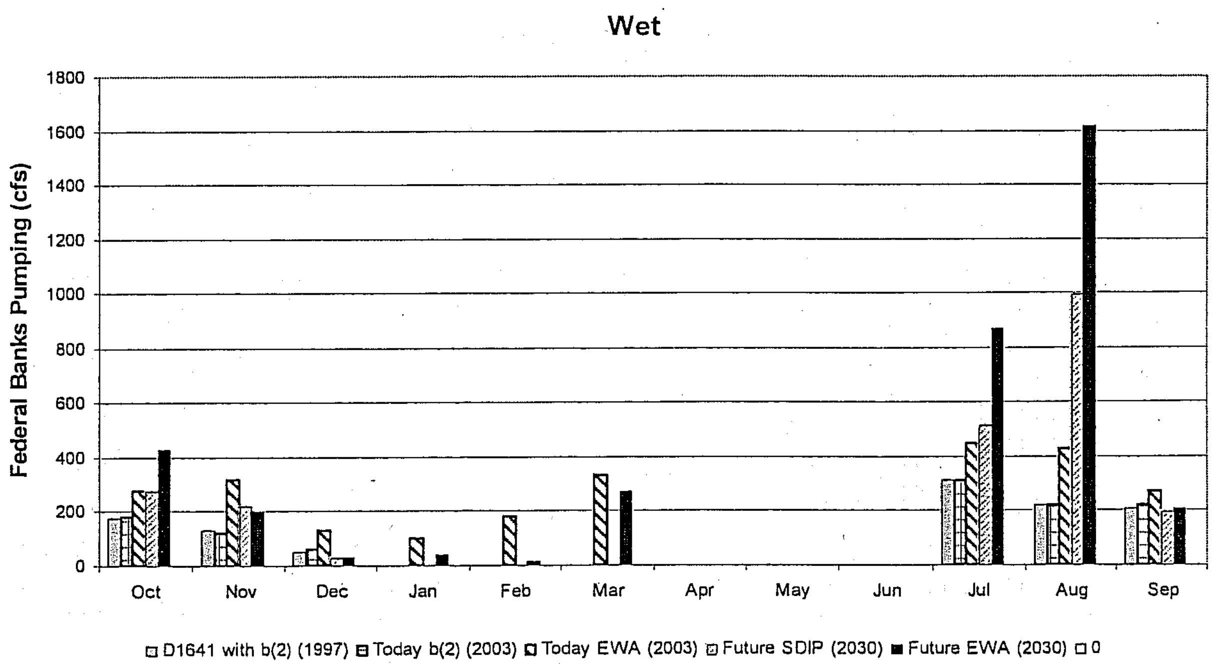


Figure 93 Average wet year (40-30-30 Classification) monthly Federal Banks Pumping

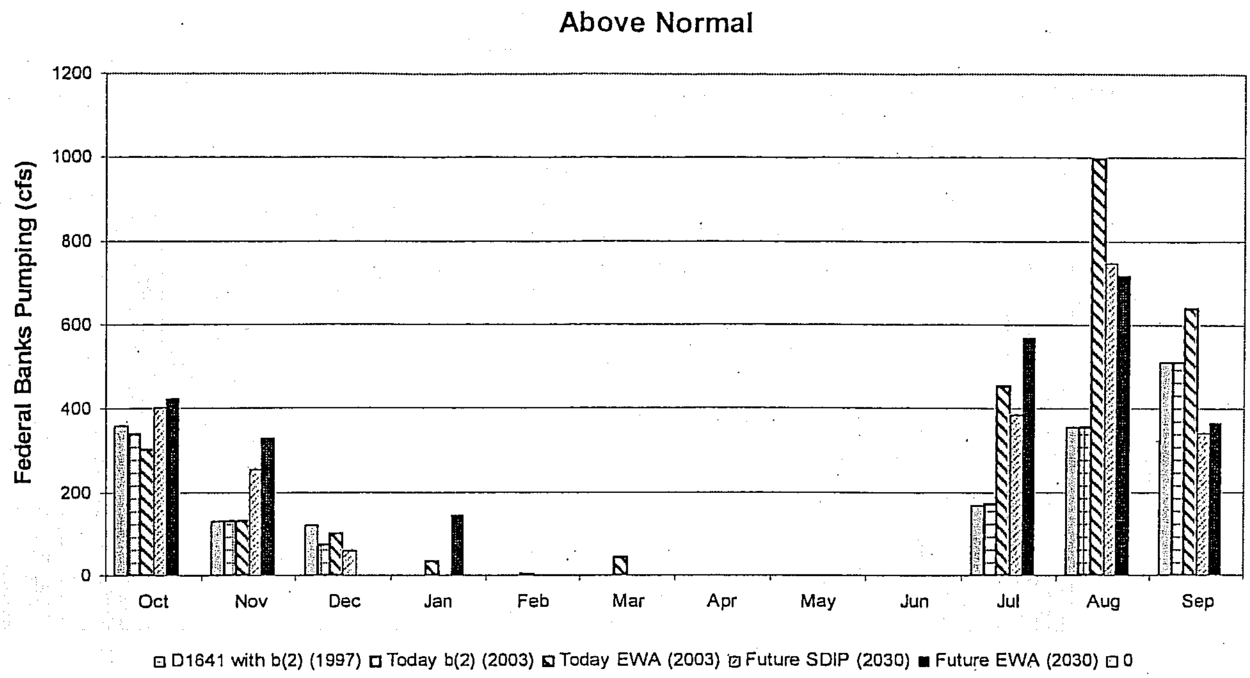


Figure 94 Average above normal year (40-30-30 Classification) monthly Federal Banks Pumping

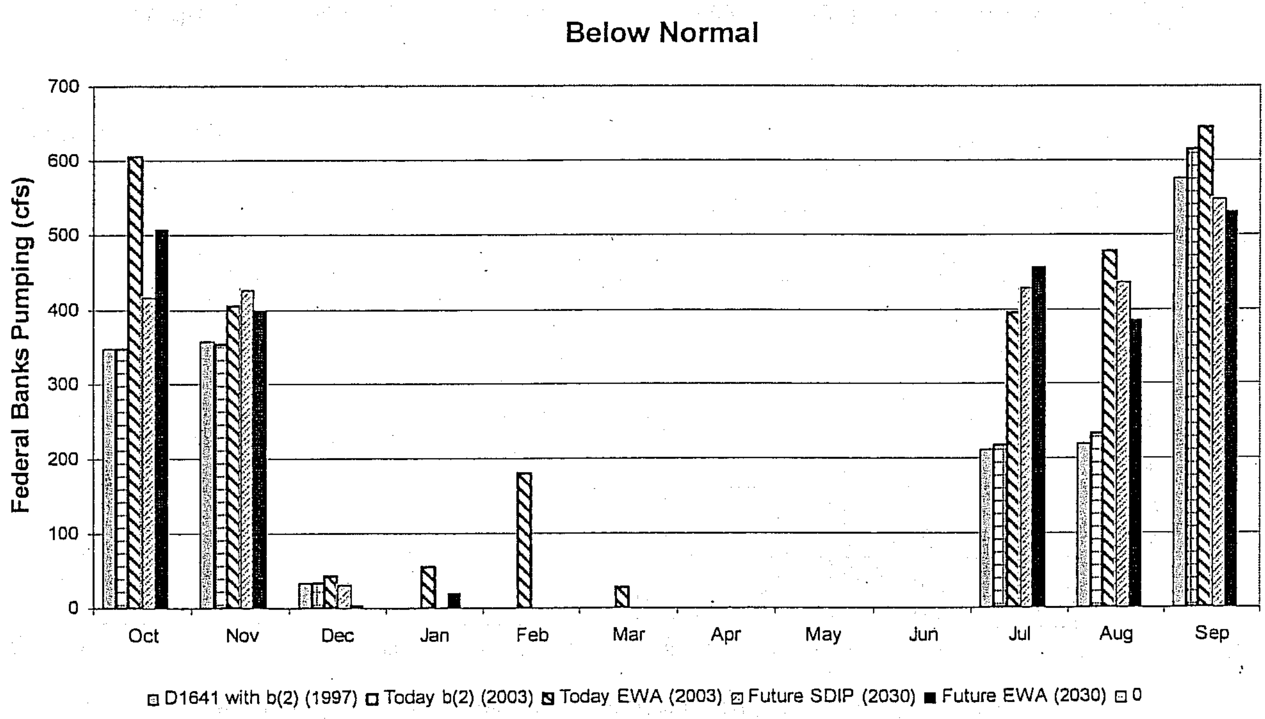


Figure 95 Average below normal year (40-30-30 Classification) monthly Federal Banks Pumping

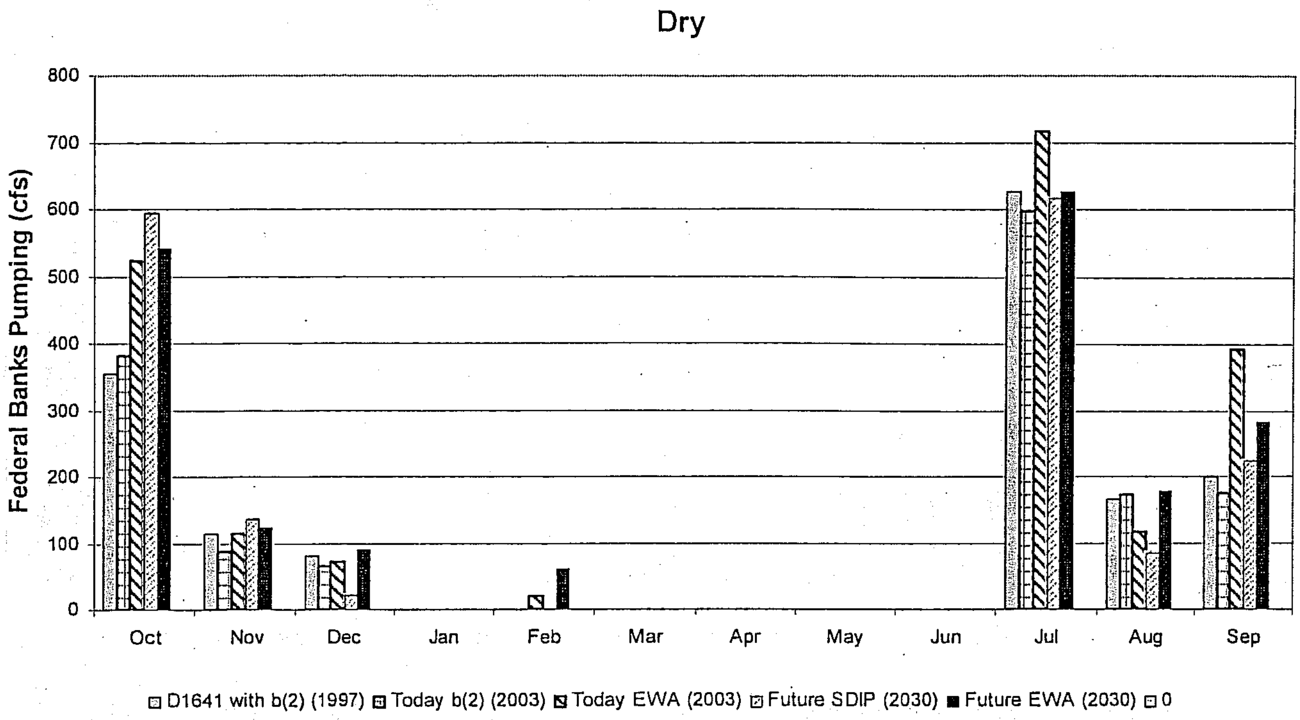


Figure 96 Average dry year (40-30-30 Classification) monthly Federal Banks Pumping

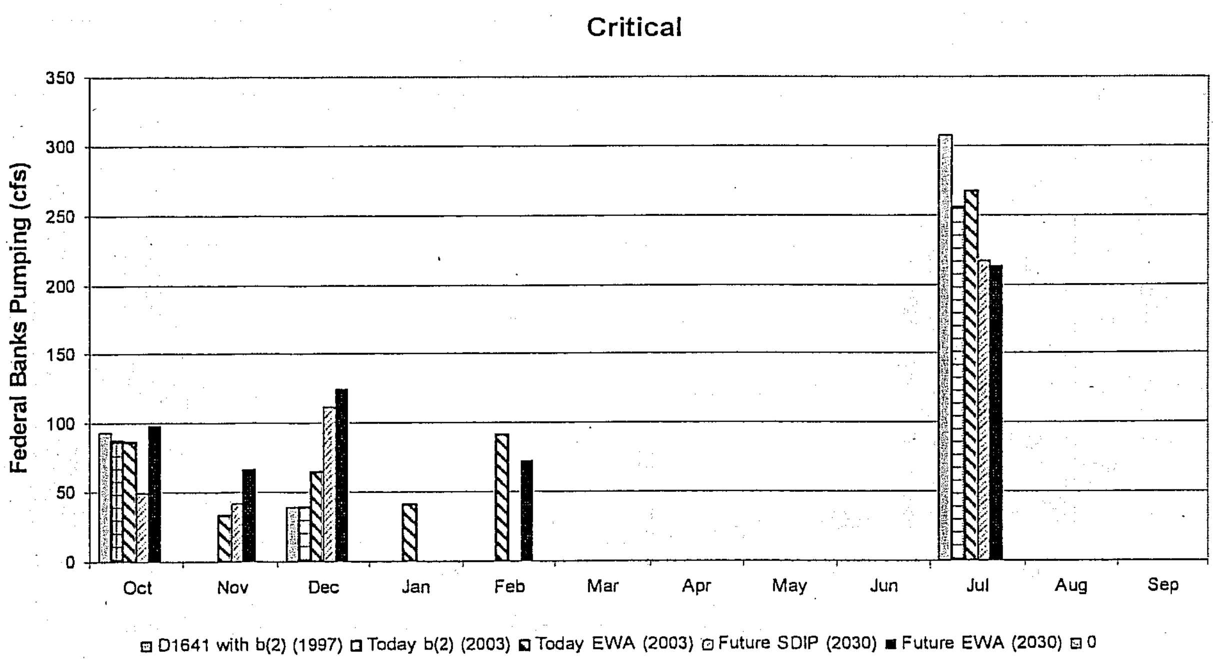


Figure 97 Average critical year (40-30-30 Classification) monthly Federal Banks Pumping

Salvage and Loss (direct and indirect) at the CVP and SWP

Direct losses to entrainment by CVP and SWP export facilities

Annually, thousands of delta smelt are entrained by the Projects and unknown percentages of the entrained fish are observed and counted in fish salvage operations. Although both the CVP and SWP have fish salvage facilities, delta smelt do not survive the salvage process, either due to stress and injury from handling, trucking and release, or from predation in or near the salvage facilities, the release sites, or in Clifton Court Forebay (DFG unpublished data). Delta smelt entrainment is highly seasonal. Adult delta smelt may be present in the south Delta and vulnerable to entrainment from about December through April; larvae and juveniles are likely to be present and vulnerable during March through early July.

Delta smelt entrainment is presently estimated (or indexed) by extrapolating catch data from periodic samples of salvaged fish (≥ 20 mm). A sub-sample of water from the facility holding tanks is extrapolated based on the volume of water diverted during collection of that sample to estimate the number of fish entrained into the facilities during the sampling interval. Intervals typically range from 1-24 hours depending on time of year, debris loads, etc. To simplify predictions of the difference in salvage (and by extension entrainment) between model scenarios, it was assumed that salvage density (fish per volume of water diverted) was independent of the pumping rate. Because salvage density also varies considerably among seasons and years, salvage density was estimated for wet and dry water year types from historical data representing the period 1993–2002. There were too few years of most water-year types to reasonably estimate salvage density for each type, so data from wet (Wet and Above Normal) and dry (Below Normal, Dry, and Critically Dry) types were pooled. Note that monthly mean salvage density estimates were used, which were dictated by the monthly time step in CALSIM II outputs. The difference in salvage between two model Studies was then computed by estimating the difference in pumping rate from the CALSIM II model output and multiplying by the corresponding salvage density estimate. Changes in salvage were estimated separately for each salvage facility and Sacramento River water-year type (salvage for the two facilities was combined for purposes of quantifying incidental take). The monthly differences were computed as $(X_y - X_1)/X_1$ where the subscript y is either 4a or 5a (corresponding to those model Studies), and X_1 represents the base Study (#1).

Salvage of adult delta smelt

In general, there is a 7 to10 percent increase in median pumping in typical years at the CVP in Study #4, while there is either no change or a trivial decrease when EWA actions are included in Study #5 (Table 22 through 31). There are smaller increases of 1.9 to 8.9 percent at the CVP in Critically Dry years in #4; the corresponding months in #5 feature either reductions in pumping relative to the base Study or no change. March is exceptional in #4, with up to a 10.8 percent decrease in pumping (relative to #1) in the wetter months.

At the SWP facility, median pumping winter pumping rate changes in wetter years ranged as high as +18 percent in December in #4 and +24.8 percent in March in #5, though most of the other wetter-year changes are +10 percent or less. In drier years median changes varied between zero and +14.4 percent, with several values above +10 percent.

In all, predicted adult salvage at the CVP differs very little in #4 and #5 from #1, and there are consistent increases of up to a few hundred individuals under both #4 and #5 at the SWP.

Table 22 CVP salvage in Wet years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	4222	+8.9%	–0.7%	0.010	+4	0
January	4226	+8.8%	–0.8%	0.095	+35	–3
February	4243	+8.3%	–2.2%	0.151	+53	–14
March	4273	–2.9%	+7.0%	0.159	–19	+47
Largely Juveniles						
April	2747	0	0	0.206	0	0
May	2274	0	0	7.430	0	0
June	3000	0	0	2.017	0	0
July	4588	+0.3%	0	0.036	0	0
Net: December – March					+73	+30
Net: April – July					0	0

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1995-2000.
[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 23 CVP salvage in Above Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	4221	+8.9%	–0.7%	0.010	+4	0
January	4225	+8.9%	–0.8%	0.095	+36	–3
February	4242	+8.4%	–2.2%	0.151	+54	–14
March	4262	–14.3%	+0.3%	0.159	–73	–45
Largely Juveniles						
April	2742	0	0	0.206	0	0
May	1911	0	0	7.430	0	0
June	2920	0	0	2.017	0	0
July	4580	+0.1%	+0.2%	0.036	0	+1
Net: December – March					+20	–62
Net: April – July					0	+1

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1995-2000.
[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 24 CVP salvage in Below Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	4221	+7.3%	–3.5%	0.067	+21	–10
January	4225	+8.9%	–0.7%	0.180	+68	–6
February	4241	+8.1%	+8.2%	0.235	+81	+82
March	4235	–3.8%	–4.8%	0.201	–32	–41
Largely Juveniles						
April	2321	0	–1.1%	0.259	0	–7
May	1911	0	–34.0%	11.93	0	–7761
June	3000	0	0	1.584	0	0
July	4554	+0.3%	+0.2%	0.005	0	0
Net: December – March					+137	+26
Net: April – July					0	–7768

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 25 CVP salvage in Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	4220	+8.9%	–0.7%	0.067		
January	4225	+8.8%	–0.8%	0.180		
February	4235	+8.4%	+8.4%	0.235		
March	4208	+1.4%	–0.8%	0.201		
Largely Juveniles						
April	1808	+0.7%	+0.9%	0.259		
May	1720	0	–38.1%	11.93		
June	2874	0	–8.9%	1.584		
July	4421	–0.3%	–5.7%	0.005		
Net: December – March						
Net: April – July						

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 26 CVP salvage in Critically Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Tracy[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	2897	+4.8%	–19.1%	0.067	+9	–37
January	4218	+8.9%	–9.7%	0.180	+67	–73
February	3979	+1.9%	–0.1%	0.235	+18	0
March	1247	+2.9%	0	0.201	+7	0
Largely Juveniles						
April	800	0	0	0.259	0	0
May	1189	0	–32.6%	11.93	0	–4638
June	953	–1.1%	0	1.584	–17	0
July	800	–1.5%	0	0.005	0	0
Net: December – March					+102	–110
Net: April – July					–17	–4638

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 27 SWP salvage in Wet years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Banks[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	7033	+18.0%	+13.7%	0.015	+19	+14
January	7408	+9.5%	+8.4%	0.214	+151	+133
February	5848	+2.4%	+4.1%	0.242	+34	+58
March	5653	+17.2%	+24.8%	0.069	+67	+97
Largely Juveniles						
April	4830	+8.7%	–19.2%	0.058	+24	–54
May	4660	+5.8%	–48.4%	12.52	+3366	–28216
June	5925	–0.1%	+7.0%	10.90	–229	+4547
July	6680	+12.7%	+17.4%	0.611	+520	+711
Net: December – March					+270	+302
Net: April – July					+3682	–23011

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1993 and 1995-2000.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 28 SWP salvage in Above Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Banks[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	6484	+9.3%	+4.8%	0.015	+8	+6
January	7548	0	–4.8%	0.214	0	–7
February	7451	+2.1%	–3.1%	0.242	+62	+103
March	5784	+14.3%	+26.6%	0.069	+60	+36
Largely Juveniles						
April	4508	+7.4%	–23.5%	0.058	+22	–66
May	3596	+2.3%	–58.3%	12.52	+1540	–22496
June	3942	+3.5%	+0.6%	10.90	+1268	–1099
July	6157	+7.7%	+27.0%	0.611	+372	+869
Net: December – March					+130	+137
Net: April – July					+3201	–22792

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Above Normal and Wet years 1993 and 1995-2000.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 29 SWP salvage in Below Normal years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Banks[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	5938	+11.2%	+6.0%	0.050	+33	+18
January	7172	+7.5%	–0.4%	0.209	+113	–7
February	5850	+2.1%	+5.7%	0.134	+17	+45
March	5713	+12.4%	+8.9%	0.178	+126	+90
Largely Juveniles						
April	3548	+1.0%	–25.2%	0.369	+13	–330
May	3235	+3.9%	–50.0%	29.97	+3792	–48444
June	3977	–0.2%	–2.6%	6.706	–50	–682
July	5320	+4.0%	+23.1%	0.446	+94	+548
Net: December – March					+289	+146
Net: April – July					+3849	–48908

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 30 SWP salvage in Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Banks[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	5358	+9.5%	+9.5%	0.050	+25	+26
January	5717	+10.0%	–8.6%	0.209	+119	–103
February	5303	+7.2%	+9.5%	0.134	+51	+67
March	4413	–0.1%	–0.1%	0.178	0	0
Largely Juveniles						
April	2168	+0.1%	–18.1%	0.369	+1	–145
May	2099	–1.8%	–58.1%	29.97	–1111	–36577
June	2952	–0.8%	–6.7%	6.706	–155	–1330
July	5217	+0.1%	+29.2%	0.446	+1	+679
Net: December – March					+196	–10
Net: April – July					–1265	–37373

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

Table 31 SWP salvage in Critically Dry years

Month	Median model Study 1 pumping (c.f.s.)	Median change in Study 4	Median change in Study 5	Density of delta smelt at Banks[a]	Predicted median difference in salvage[b]	
					4 – 1	5 – 1
Adults						
December	4267	+6.0%	–5.9%	0.050	+13	–12
January	4891	+6.2%	–13.2%	0.209	+63	–135
February	3198	+13.4%	+14.4%	0.134	+58	+62
March	2030	+14.2%	+0.3%	0.178	+51	+1
Largely Juveniles						
April	1197	0	0	0.369	0	0
May	1189	0	–32.7%	29.97	0	–11652
June	300	0	0	6.706	0	0
July	553	–1.1%	+53.5%	0.446	–3	+132
Net: December – March					+185	–84
Net: April – July					–3	–11521

[a] Average delta smelt salvage density (fishes c.f.s.$^{-1}$ month^{-1}) estimated from pooled Dry and Critically Dry years 1994 and 2001-2.

[b] Predicted median difference has unit: fishes month.$^{-1}$. See text for explanation of calculation.

These tables show that under study 4, an increase in the salvage of delta smelt occurs over the number of smelt salvaged in study 1 (see the second column from the right in the tables above). When the EWA is added in study 5, the increases in salvage are reversed and take is reduced in study 1 (see the far right column in the tables above). It should be noted that the EWA as modeled only uses placeholders that reduce exports in a regular pattern during the spring and summer, and these actions do not correlate to actual salvage events at the fish facilities. In actual operations and by using the DSRAM, more informed use of the EWA actions in a proactive manner will likely reduce salvage even further.

Salvage of Juvenile Delta Smelt

All comparisons of Studies #4 and #5 are with Study #1. There are only small changes in juvenile salvage at the CVP facility under both Study #4 and Study #5. Changes at Banks under Study #4 are also small. There are substantial median reductions in Banks pumping in April and May when EWA actions are added in Study #5. These would result in reductions in juvenile smelt salvage during those months that might benefit the species in some years, particularly those in which high entrainment episodes would otherwise occur during that period (particularly in May).

It should be noted that although salvage is used to index delta smelt take, it does not reliably index delta smelt entrainment. Furthermore, delta smelt salvage is highly variable at all time scales, because they are patchily distributed, spawn at different times and places from year to year, and larval dispersal is influenced by hydrodynamic conditions operating on tidal time scales. Salvage efficiencies also vary daily and seasonally due to changes in operations, size of the fish, and presumably metabolic demands of predators hunting within the facilities. Consequently, while this analysis credibly predicts what might happen in typical years, there will – even under the "baseline" Study 1 scenario – certainly be a small percentage of future years in which the confluence of natural and anthropogenic circumstances cause large delta smelt entrainment episodes. Delta smelt typically spend more time closer to the export facilities under low-flow conditions and in relatively cool years with low to intermediate flows, making these episodes more likely under those conditions. Because an analysis of the likelihood of these events would require modeling delta smelt movement using detailed historical distributional data that does not exist, we cannot determine whether the frequency of large entrainment events would be different from Study #1 under Studies #4 or #5. More sophisticated models and shorter time-scale monitoring of young smelt distribution may provide a means to resolve this question in the future. (BA 2004)

Salvaged numbers of delta smelt do not adequately reflect the actual number of smelt that are lost at the CVP and SWP. The current salvage facilities use a louver system that is efficient for salmon and striped bass, but has unknown efficiency for delta smelt. Predation on delta smelt in Clifton Court Forebay also affects the salvage efficiency at the SWP. The collection, handling and transport studies (CHTR) currently underway propose to evaluate methods to improve handling, such that some delta smelt may survive the salvage process. In addition, a more complete understanding of the salvage efficiencies at the projects would improve estimates of the number of delta smelt entrained.

Article 21 Effects

The assumptions in CALSIM II for the demands that drives Banks Pumping varies by month with some variation across years. The demand for Article 21 water is one component of this total demand. In general, the assumed demand December through March for Article 21 water in CALSIM II is 134 taf per month–the assumed demand December through March Article 21 accounts for 90 percent of the annual total. With this assumed demand, 400 taf or more of Article 21 water is diverted 10 percent of the time (see Figure 10-46 of the BA).

It is likely that if the demand is assumed higher in these months, more may be diverted. To test this sensitivity DWR staff conducted an auxiliary simulation based on Study 2 with a demand set at 203 taf January through March (in the original Study 2, demand is never fully met in December) and with a demand of 300 taf January through March. With these higher demands 400 taf or more of Article 21 water is delivered 26 percent of the time. One other result worth noting is that based on Study 4 (a future conditions study with the same Article 21 demands as Study 2), there is an 8 percent chance of delivering 400 taf or more Article 21 water between December and March in any given year.

These differences are appropriately illustrated in the larger context of total SWP diversions from the South Delta in Figure 10-47 of the BA. For example, there is a 32 percent chance that Banks Pumping will total 1600 taf or more December through March assuming an Article 21 demand of 134 taf/month; the chances increase to 36 percent assuming an Article 21 demand of 203 taf/month and 41 percent assuming an Article 21 demand of 300 taf/month. These differences are best characterized with the probabilistic exceedance plots. Nevertheless, a similar characterization is illustrated in Figure 10-48 of the BA, which depicts the total Banks diversions with the different Article 21 demands averaged by water year type. A corollary look at the effects on the position of X2 is presented in Figure 10-49 of the BA.

The effects of Article 21 pumping on delta smelt are not expected to be very significant. The most pumping of Article 21 water occurs during above normal or wet water years, when delta smelt are not likely to be near the projects. Also, outflows and X2 requirements will continue to be met during Article 21 pumping, so delta smelt habitat is not likely to be significantly affected by the pumping of Article 21 water. An increase in smelt take at the TFCF or at the Skinner Fish Facilities could occur as a result of Article 21 pumping if delta smelt are present in the south Delta at the time of the pumping.

Intertie Effects

The DMC and CA Intertie (Intertie) consists of consruction and operation of a pumping plant and pipeline connections between the Delta Mendota Canal and the California Aqueduct. The Intertie would include a 400 cfs pumping plant to allow up to 400 cfs to be pumped from the DMC to the CA. Up to 950 cfs could be conveyed from the CA to the DMC using gravity.

The Intertie would allow the Tracy pumping plant to export to its authorized capacity of 4,600 cfs (currently 4,200 cfs), subject to all applicable export pumping restrictions for fishery protections and water quality. These increased export amounts were modeled in the CALSIM II modeling and the salvage of delta smelt is expected to increase as a result of the increase in maximum pumping at Tracy up to 4,600 cfs. The effects of the increase in the number of salvaged delta smelt at the Tracy fish facilities is described in the Salvage and Loss section of the Effects section.

Water Transfers Effects

Water transfers would increase Delta exports from 200,000-600,000 AF in about 80% of years. Most transfers would occur during July through September. Delta smelt are not likely to be present in the south Delta during this time (DFG unpublished data). However, delta smelt may still inhabit parts of the Delta in the zone of influence in July of some years. Water transfers may also occur outside of the July through September period and would be subject to all current water quality and pumping restrictions. As described in the project description, transfers will take place at times when delta smelt will not be adversely affected by the transfer and Reclamation and DWR will coordinate these transfers through the B2IT, EWAT and WOMT. The effects of transferring the water for terrestrial species would need to be handled in a separate Section 7 consultation.

Effects of Operation of Permanent Barriers

The effects of the permanent barriers are presumed to be similar to the temporary barriers since the permanent barriers would be closed (operated) in a similar manner to the temporary barriers. The effects of construction of the permanent barriers and any associated dredging will be covered in a separate consultation.

Head of Old River Barrier

Under the project description, the Head of Old River barrier (HORB) would be closed at the start of VAMP, which starts approximately around the middle of April and will remain closed for 31 days. The barrier will also be closed in the fall during October and November. There are additional conditions under which the fishery agencies may request that the barrier be closed (see the Project Description for more detail).

Agricultural Barriers

Under the project description, from April 15 through November 30, the agricultural barriers on Middle River, Old River and on Grant Line Canal would be operated with the permission of the Service and NOAA Fisheries on an as-needed basis to protect water quality and stage in the south Delta. From December 1 through April 15, the barriers on Middle River, Old River and Grant Line Canal would be closed to protect water quality and stage only if the Service, NOAA Fisheries and DFG determined that no increase in take would occur from the barrier closure.

The closures of the barriers in the south Delta impose a number of adverse effects on the delta smelt. The closure of the HORB in the spring could change the hydrology of the south and central Delta and may cause smelt to move towards the south Delta export facilities rather than out to Suisun Bay. The HORB closure could also degrade central Delta water quality by directing poorer quality San Joaquin River water to the central Delta. The closure of the agricultural barriers could prevent flow cues in the Delta upon which adult delta smelt may rely. These flows cues may be important from December through March, and closure of the barriers during this time may interfere with upstream and downstream migrations of smelt. Additionally, the closure of the barriers could decrease water quality and increase water temperatures behind the barriers. Smelt could also be subjected to higher entrainment in agricultural diversions behind the barriers as well as increased predation.

However, since all the permanent South Delta barriers are operable, the Service or the delta smelt working group may recommend that any barrier be opened to help protect delta smelt from entrainment, high water temperatures or other adverse conditions. These openings may help to allow juvenile delta smelt to move from the south and central Delta to Suisun Bay. The proposed barrier operations should be an improvement over the temporary barriers since the permanent barriers will be operated more precisely to close the barriers the minimum amount required to maintain water levels. This will allow smelt to have the ability to pass the barriers for the few hours when the barriers are open. The Service may request that the barriers remain open for longer periods if smelt distributions are a concern.

CVP and SWP Coordination items effects

San Luis Low Point
Since the effects to delta smelt are not clear, prior to the implementation of the San Luis low point as described in the project description, the Service, NOAA Fisheries and DFG will be notified to determine if the proposed San Luis operations will adversely affect delta smelt.

Upstream Reservoir Coordination
After reviewing the Future modeling the times when Oroville storage is less than 1,500,000 af and Shasta is over 2,400,000 af only occurs twice (1961 and 1962). Since this happens in only about 3% of the years covered by the available data, the conditions seem rare for this to happen more frequently. Prior to implementation of this action, Reclamation will notify the Service, NOAA Fisheries, and DFG to determine if delta smelt will be harmed as a result of this action.

Conservation Measures
A number of conservation measures are expected to continue in the future as part of the proposed action. These measures provide protection for delta smelt and/or their habitats and it is important to continue these protections in the future to maintain or improve delta smelt populations in the Delta. These baseline conditions will continue in the future as part of the project description and will help provide protection to delta smelt throughout their life cycle. These measures are further described in the Project Description.

Water Rights Decision 1641

Under the Water Quality Control Plan, flows and water quality objectives help maintain delta smelt habitat quality during their early life stages. In particular, X2 and E:I ratio requirements to reduce delta smelt entrainment risk (for more details see the X2 effects section).

VAMP

The Vernalis Adaptive Management Plan provides pulse flows in the San Joaquin River and lower Delta exports during April and May which is thought to improve transport and habitat conditions for delta smelt.

EWA

The Environmental Water Account, as modeled, reduces exports during periods considered critical to delta smelt. Primarily via export reductions, it helps reduce salvage at the CVP and SWP. It provides an important adaptive management mechanism to benefit delta smelt.

CVPIA (b)(2)

Water that is part of the CVPIA (b)(2) account can be used to reduce exports at the SWP and CVP. These reductions help reduce entrainment of smelt in the same way that EWA does.

Adaptive Management process

The Adaptive Management section of the Project Description describes a number of groups and teams which meet to discuss potential operational actions to be taken to benefit delta smelt. These groups use the salmon decision tree and the DSRAM to determine a concern level and which actions are appropriate to protect fish. The delta smelt working group uses the DSRAM to determine if the level of concern is sufficient to recommend an action to be taken to protect smelt. By using the various groups and teams, proactive actions may help avoid high salvage events and improve habitat conditions.

Summary of Effects

In summary, the operations of the Projects under formal consultation as described in the Project Description will result in adverse effects to delta smelt through entrainment at the CVP and SWP and by drawing delta smelt into poorer quality habitat in the south delta. However, with the inclusion of the conservation measures described above and the implementation of the DSRAM, these adverse effects would be avoided or minimized. With these conservation measures in place, the re-operation of the Trinity River, the increased level of development on the American River, the Freeport Diversion, the Suisun Marsh Salinity Control Gates, the Barker Slough Diversion, or due to changes to X2, as described in the Project Description, are not expected to result in adverse effects delta smelt

Critical Habitat Effects

Critical habitat is not likely to be adversely modified or destroyed as a result of the early consultation proposed project. The primary constituent elements essential to the conservation of the species will not be affected by the proposed project. Pumping at the CVP and SWP pumping facilities as a result of the proposed project will not result in a loss of physical habitat in the delta. River flows and water in the delta will continue to be adequate to provide spawning, rearing and foraging habitat for the smelt. The salinity of the delta will not be modified beyond the normal fluctuations as a result of this project, as the location of X2 during February through June will not change significantly as a result of this project. Breeding habitat will not be substantially affected by the proposed project, and the sustainability of the food base for delta smelt will not be changed by the proposed project. In addition, adequate flows and reduced exports during the delta smelt spawning and rearing seasons will protect delta smelt and these protections will remain in place as long as the WQCP 1641 requirements continue to be met.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions affecting listed species that are reasonably certain to occur in the area considered in this biological opinion. Future Federal actions not related to this proposed action are not considered in determining the cumulative effects, but are subject to separate consultation requirements pursuant to section 7 of the Act.

Any continuing or future non-Federal diversions of water that may entrain adult or larval fish would have cumulative effects to the smelt. Water diversions through intakes serving numerous small, private agricultural lands contribute to these cumulative effects. These diversions also include municipal and industrial uses. State or local levee maintenance may also destroy or adversely modify spawning or rearing habitat and interfere with natural long term habitat-maintaining processes.

Additional cumulative effects result from the impacts of point and non-point source chemical contaminant discharges. These contaminants include but are not limited to selenium and numerous pesticides and herbicides as well as oil and gasoline products associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for smelt, these contaminants may adversely affect fish reproductive success and survival rates. Spawning habitat may also be affected if submersed aquatic plants, used a substrates for adhesive egg attachment, are lost due to toxic substances.

Other cumulative effects could include: the dumping of domestic and industrial garbage may present hazards to the fish because they could become trapped in the debris, injure themselves, or ingest the debris; golf courses reduce habitat and introduce pesticides and herbicides into the environment; oil and gas development and production remove habitat and may introduce pollutants into the water; agricultural uses on levees reduce riparian and wetland habitats; and grazing activities may degrade or reduce suitable habitat, which could reduce vegetation in or near waterways.

The cumulative effects of the proposed action is not expected to alter the magnitude of cumulative effects on the above described actions upon the critical habitat's conservation function for the smelt

Conclusion

After reviewing the current status of the smelt, environmental baseline for the species, the effects of the proposed project, and the cumulative effects on these species, it is the Service's biological opinion that the proposed project, as described herein, is not likely to jeopardize the continued existence of the smelt because of the DSRAM, D-1641, EWA and other conservation measures.

In evaluating the Status of the Species for critical habitat and the Environmental Baseline, while there are current actions that result in adverse effects to delta smelt critical habitat, the primary constituent elements continue to remain functional for the smelt. In the effects section, the Service determined that the primary constituent elements of delta smelt critical habitat would not be affected by the proposed project since there will not be a loss of physical habitat in the delta, river flows will continue to provide habitat, salinity will not be affected by the proposed project, and no breeding habitat will be affected and the sustainability of the food base will not be affected. In the cumulative effects section, we determined that the cumulative effects of the proposed action are not expected to alter the magnitude of future actions' effects on critical habitat's conservation function for the smelt. Based on the analysis in these four areas, it is our conclusion that Critical habitat is not likely to be adversely modified or destroyed as a result of implementing the proposed project.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The reasonable and prudent measures described below are nondiscretionary and must be implemented by Reclamation and DWR so they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. Reclamation and DWR have a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take-Formal Consultation

The Service anticipates that incidental take of delta smelt will occur in the form of harassment and mortality by operating the CVP and SWP. The Service also anticipates that incidental take of delta smelt will occur at the Barker Slough intake at the NBA and through studies done to determine screening criteria and improve delta smelt handling and survival in the salvage process. Take for these studies and for take at the Barker Slough intake is allowed. However, the Service anticipates that any take of delta smelt at the Skinner and TFCF will be difficult to detect and quantify for a number of reasons: they have a relatively small body size; they are relatively secretive; their presence in the Delta coincides with relatively turbid conditions, which makes their detection difficult, their presence in aquatic vegetation makes them difficult to detect, the species is wide-ranging and its distribution varies from one year to the next, the level of predation is unknown, and losses of the species may be masked by seasonal fluctuations in numbers. Therefore, it is not possible to provide precise numbers of delta smelt that could be injured, harassed, harmed, or killed from the long-term operation of the CVP and SWP.

This take statement was developed by projecting the total number of smelt salvaged at both salvage facilities if the export facilities are operated as modeled in the CALSIM II studies. Delta smelt salvage densities (numbers of fishes per unit water exported) were estimated for each month from historical (1993-2003) data. Because wet-year salvage has historically differed from dry-year salvage, separate estimates were computed for wet (Wet and Above Normal) years and dry (Below Normal, Dry, and Critically Dry) years. To project future salvage, we multiplied the monthly export pumping reported by CALSIM II by the corresponding estimated monthly salvage density appropriate for that month and water year type. From these data we computed the median predicted salvage for each month in wet and dry years.

The delta smelt salvage density estimates employed to develop this incidental take statement were computed from the eleven years from 1993 through 2003. Of those years only three were classified as dry or critical year types. The rest were above normal or wet. Because of the limited number of drier year-types, it would be most prudent statistically to aggregate the year types into wetter years (above normal and wet) and drier years (critical, dry, and below normal). Because we have developed these estimates from few data, however, they are uncertain. Total annual salvage has varied widely in the past, and this will probably continue.

Furthermore, there is greater practicality with the implementation of just two year types. Because the classification of a year can change from month to month depending on hydrology and because this change doesn't occur until the eighth of each month January through May, it is impractical to use a take statement for each month based on the particular year type. However, year types. changes when they do occur typically only change from one year type to the next, such as dry to below normal. Rarely does a year type change in the extreme such as dry to wet. Therefore using just wetter or drier year types should prove manageable for the project operators and the use of the Delta Smelt workgroup.

Salvage rates do not necessarily index how facility operations affect the delta smelt population. In years when delta smelt are numerous and widely distributed, high salvage rates may not be of great concern. Conversely, in years when there are few delta smelt and they are distributed in areas vulnerable to entrainment at the export facilities, even low salvage rates may be of great concern. Entrainment of prespawning adults is of greater concern than entrainment of juveniles, as prespawning adults are individually more important to the perpetuation of the species. The DSRAM incorporates this information and identifies variables that the Working Group will examine to decide whether action should be taken to try to reduce salvage. However, the DSRAM was not included among the assumptions of the CALSIM II modeling and its effectiveness is as-yet unknown. This analysis and information is described in the effects section of the biological opinion.

To ensure that the Working Group closely monitors the effects of salvage on the delta smelt population, we have chosen the median predicted salvage, as described above, as a trigger for the Working Group to meet. While we are confident that use of the DSRAM will reduce the frequency with which actual salvage exceeds the median predicted salvage, the exceedence frequency could be as high as 50%. When incidental take is exceeded, the Working Group will convene a meeting to determine and recommend: 1) the actions, if any, that should be taken to reduce salvage and, 2) if the Service should consider reinitiation of consultation. Should the Working Group recommend reinitiation of consultation, the Service will determine if the reinitiation of consultation is warranted.

The incidental take by water year type is as follows:

		Water Year Type	
	Month	**Wet or Above Normal**	**Below Normal, Dry, or Critical**
Monthly incidental take	**October**	100	100
	November	100	100
	December	700	400
	January	3000	1900
	February	2300	1700
	March	1300	1300
	April	1000	1100
	May	37800	30500
	June	45300	31700
	July	3500	2500
	August	100	100
	September	100	100

The Water year is based on the 90 % exceedance forecast, which is updated monthly throughout the water year. The amount of combined salvage was determined using historical delta smelt densities from 1993 through 2003 and future exports from CALSIM II study #5a. The WQCP, B2, and EWA are included in CALSIM II Study #5a, and anticipated take can best be determined from the modeling done for Study 5a.

In the months of December through April, primarily adult delta smelt are salvaged, while from May through July mostly juvenile delta smelt are salvaged. These numbers have been rounded to the nearest 100. From August through November very few delta smelt are in the Delta. For those four months, the Service set a take level of 100. Incidental take of delta smelt from the pilot larval delta smelt monitoring and future larval delta smelt monitoring is included in the above expected take table.

Upon implementation of the following reasonable and prudent measures, Reclamation and DWR will become exempt from the prohibitions described under section 9 of the Act for incidental take associated with the long-term operation of the Central Valley Project and the State Water project in the form of harm, harassment, injury, or mortality to delta smelt.

Preliminary Amount or Extent of Take-Early Consultation

The Service anticipates that incidental take of delta smelt will occur in the form of harassment and mortality by operating the CVP and SWP. The Service anticipates that incidental take of delta smelt will occur at the Barker Slough intake at the NBA, through the operations of the permanent barriers, and through studies done to determine screening criteria and improve delta smelt handling and survival in the salvage process. Take for these studies and for take at the Barker Slough intake and the operations of the permanent barriers is allowed. However, the Service anticipates that any take of delta smelt at the Skinner and TFCF will be difficult to detect and quantify for a number of reasons: they have a relatively small body size; they are relatively secretive; their presence in the Delta coincides with relatively turbid conditions, which makes their detection difficult, their presence in aquatic vegetation makes them difficult to detect, the species is wide-ranging and its distribution varies from one year to the next, the level of predation is unknown, and losses of the species may be masked by seasonal fluctuations in numbers. Therefore, it is not possible to provide precise numbers of delta smelt that could be injured, harassed, harmed, or killed from the long-term operation of the CVP and SWP.
This take statement was developed by projecting the total number of smelt salvaged at both salvage facilities if the export facilities are operated as modeled in the CALSIM II studies. Delta smelt salvage densities (numbers of fishes per unit water exported) were estimated for each month from historical (1993-2003) data. Because wet-year salvage has historically differed from dry-year salvage, separate estimates were computed for wet (Wet and Above Normal) years and dry (Below Normal, Dry, and Critically Dry) years. To project future salvage, we multiplied the monthly export pumping reported by CALSIM II by the corresponding estimated monthly salvage density appropriate for that month and water year type. From these data we computed the median predicted salvage for each month in wet and dry years.

The delta smelt salvage density estimates employed to develop this incidental take statement were computed from the eleven years from 1993 through 2003. Of those years only three were classified as dry or critical year types. The rest were above normal or wet. Because of the limited number of drier year-types, it would be most prudent statistically to aggregate the year types into wetter years (above normal and wet) and drier years (critical, dry, and below normal). Because we have developed these estimates from few data, however, they are uncertain. Total annual salvage has varied widely in the past, and this will probably continue.

Furthermore, there is greater practicality with the implementation of just two year types. Because the classification of a year can change from month to month depending on hydrology and because this change doesn't occur until the eighth of each month January through May it is impractical to use a take statement for each month based on the particular year type. However, year types changes when they do occur typically only change from one year type to the next, such as dry to below normal. Rarely does a year type change in the extreme such as dry to wet. Therefore using just wetter or drier year types should prove manageable for the project operators and the use of the Delta Smelt workgroup.

Salvage rates do not necessarily index how facility operations affect the delta smelt population. In years when delta smelt are numerous and widely distributed, high salvage rates may not be of great concern. Conversely, in years when there are few delta smelt and they are distributed in areas vulnerable to entrainment at the export facilities, even low salvage rates may be of great concern. Entrainment of prespawning adults is of greater concern than entrainment of juveniles, as prespawning adults are individually more important to the perpetuation of the species. The DSRAM incorporates this information and identifies variables that the Working Group will examine to decide whether action should be taken to try to reduce salvage. However, the DSRAM was not included among the assumptions of the CALSIM II modeling and its effectiveness is as-yet unknown. This analysis and information is described in the effects section of the biological opinion.

To ensure that the Working Group closely monitors the effects of salvage on the delta smelt population, we have chosen the median predicted salvage, as described above, as a trigger for the Working Group to meet. While we are confident that use of the DSRAM will reduce the frequency with which actual salvage exceeds the median predicted salvage, the exceedence frequency could be as high as 50%. When incidental take is exceeded, the Working Group will convene a meeting to determine and recommend: 1) the actions, if any, that should be taken to reduce salvage and, 2) if the Service should consider reinitiation of consultation. Should the Working Group recommend reinitiation of consultation, the Service will determine if the reinitiation of consultation is warranted.

The preliminary incidental take by water year type is as follows:

		Water Year Type	
	Month	**Wet or Above Normal**	**Below Normal, Dry, or Critical**
Monthly incidental take	**October**	100	100
	November	100	100
	December	900	400
	January	3400	1900
	February	2400	1700
	March	1300	1300
	April	1000	1100
	May	28700	30500
	June	44800	33200
	July	3900	2500
	August	100	100
	September	100	100

The Water year is based on the 90 % exceedance forecast, which is updated monthly throughout the water year. The amount of combined salvage was determined using historical delta smelt densities from 1993 through 2003 and future exports from CALSIM II study #5. The WQCP, B2, and EWA are included in CALSIM II Study #5a, and anticipated take can best be determined from the modeling done for Study 5.

In the months of December through April, primarily adult delta smelt are salvaged, while from May through July mostly juvenile delta smelt are salvaged. These numbers have been rounded to the nearest 100. From August through November very few delta smelt are in the Delta. For those four months, the Service set a take level of 100. Incidental take of delta smelt from the pilot larval delta smelt monitoring and future larval delta smelt monitoring is included in the above expected take table.

Take associated with the construction of the permanent south Delta barriers is not authorized as a part of this biological opinion. Take for the operations of the permanent south Delta barriers is minimized by the proposed operations in the project description. The barriers would be closed mostly during the summer months, when delta smelt effects are smaller and the barriers would also be able to be opened when the Service or the delta smelt working group determine that delta smelt are being harmed by closed barriers.

Because the early consultation project elements are likely to result in the taking of listed species incidental to those actions, the Service has included an incidental take statement pursuant to section 7(b)(4) of the Act. However, because this is an early consultation on the prospective action, this incidental take statement does not eliminate Reclamation's liability under the taking prohibitions of section 9 of the Act.

Instead, this statement provides your agency and the applicant with foreknowledge of the anticipated incidental take that will occur if this prospective application is filed with your agency. The incidental take statement for the early consultation will become effective only after the Service confirms the preliminary biological opinion on the prospective action.

Effect of the Take

The Service has determined that this level of anticipated take for the formal consultation is not likely to result in jeopardy to the smelt because this level of take is at or below historical levels of take.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of listed species:

1. Minimize the potential for harassment, harm, injury and mortality to the smelt.

2. Continue to monitor delta smelt throughout their life history

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary:

The following terms and conditions implement the reasonable and prudent measure #1 (*Minimize the potential for harassment, harm, injury and mortality to the smelt.*):

A. The Project shall be implemented as described.

B. All cultured delta smelt that are used for experiments or studies at the fish facilities will not be allowed to be released into the wild. These fish will be retained in captivity after these studies conclude.

The following term and condition implements the reasonable and prudent measure #2 (*Continue to monitor delta smelt throughout their life history*):

A. The following surveys will continue to be conducted to determine abundance and distribution of delta smelt: Spring Kodiak trawl, 20mm survey, summer townet survey, and fall midwater trawl survey. Any changes to these surveys would be subject to Service (as part of WOMT) approval.

Reporting Requirements

The Service should be notified in writing within three (3) working days of the finding of any dead or injured smelt associated with the proposed project. Notification should include the date, time, and location of the incident or of the finding of a dead or injured animal plus any other pertinent information. The Service contact for this information is Jan C. Knight, Chief of the Endangered Species Division at (916) 414-6620.

Any killed specimens of fish have been taken should be properly preserved in accordance with Natural History Museum of Los Angeles County policy of accessioning (10% formalin in quart jar or freezing). Information concerning how the fish was taken, length of the interval between death and preservation, the water temperature and outflow/tide conditions, and any other relevant information should be written on 100% rag content paper with permanent ink and included in the container with the specimen. Preserved specimens shall be delivered to the Service's Division of Law Enforcement at 2800 Cottage Way, Room W-2928 Sacramento, California 95825, phone (916) 414-6660.

The U.S. Fish and Wildlife Service Regional Office in Portland, Oregon, must be notified immediately if any dead or sick listed wildlife species is found in or adjacent to pesticide-treated areas (including fungicide, herbicide, bird or animal control treatments). Cause of death or illness, if known, also should be conveyed to this office. The appropriate contact is Richard Hill at (503) 231-6241.

Delta smelt salvage information will be reported to the Service in an annual report which will be submitted to the Service by February 28 of the following year. An annual report of the studies conducted at the CVP or SWP fish facilities will also be submitted to the Service.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases.

1. The Service recommends that Reclamation develop and implement restoration measures in areas designated in the Delta Fishes Recovery Plan (USFWS 1996).

2. The Service recommends that Reclamation help improve population estimates of delta smelt and pumping impacts to the population.

3. The Service recommends Reclamation improve delta smelt survival and impacts of predation at Clifton Court Forebay and at the CVP and SWP salvage facilities.

4. The Service recommends that Reclamation, in conjunction with the Service, DWR and DFG pursue new methods for determining incidental take at the CVP and SWP.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and proposed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation with Reclamation on the proposed coordinated operations of the CVP and SWP and the OCAP in California. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or (4) a new species or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

This concludes early consultation for the coordinated operations of the CVP and SWP and the OCAP in California. You may ask the Service to confirm this preliminary biological opinion as a final biological opinion on the prospective action. The request must be in writing. If the

Service reviews the proposed action and finds that there are no significant changes in the action as planned or in the information used during the early consultation, it will confirm the preliminary biological opinion as a final biological opinion on the project and no further section 7 consultation will be necessary except when one of the following criteria for reinitiation is met: 1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or (4) a new species or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If the Service does not confirm this preliminary biological opinion as a final biological opinion on the prospective action, Reclamation is required to initiate formal consultation with the Service.

If you have any questions regarding this biological opinion on the coordinated operations of the CVP and SWP and the OCAP in California, please contact Ryan Olah or Cay Goude of the Sacramento Fish and Wildlife Office at (916) 414-6625.

cc:
ARD (ES), Portland, OR
National Marine Fisheries Service, Sacramento, CA (Attn.: Michael Aceituno)
California Department of Fish and Game, Sacramento, CA
California Department of Water Resources, Sacramento, CA

Literature Cited

Aceituno ME. 1993. The relationship between instream flow and physical habitat availability for chinook salmon in the Stanislaus River, California. USFWS Ecological Services, Sacramento Field Office. 71 p.

Arthur, J.F. and M.D. Ball 1978. Entrapment of suspended materials in the San Francisco Bay-Delta Estuary. U.S. Dept. Interior, Bureau of Reclamation, Sacramento, California.

______. 1979. Factors influencing the entrapment of suspended material in the San Francisco Bay-Delta Estuary. Pages 143-174 *in* T.J. Conomos, editor. Pacific Division, Amer. Assoc. Advance. Sci., San Francisco, California

______. 1980. The significance of the entrapment zone location to the phytoplankton standing crop in the San Francisco Bay-Delta Estuary. U.S. Dept. Interior, Water and Power Resources Service.

Bennett, William A. 2003. The Population Ecology of Delta Smelt in the San Francisco Estuary. 44 pp.

Brett, J.R. 1976. Scope for metabolism and growth of sockeye salmon *Oncorhynchus nerka*, and some related energetics. Journal of the Fisheries Research Board of Canada 33:307-313.

Bureau of Reclamation. 2003. Notice of Initiation of Federal Feasibility Studies. Mid-Pacific Regional Office, Sacramento California.

CALFED Bay Delta Program. 2002. Annual Report 2002. Sacramento, California. 80 pp.

______. 2003a. CALFED Los Vaqueros Reservoir Studies [database on the internet]. Updated on May 27, 2003. Available from http://www.lvstudies.com/default.asp. Accessed on October 10, 2003.

______. 2003b. CALFED Implementation: The Role of the Napa Proposal. Powerpoint Presentation. Sacramento, California.

[Corps] (U.S. Army Corps of Engineers). 1987. Folsom Dam and Lake, American River, California. Water Control Manual. Appendix VIII to Master Water Control Manual Sacramento River Basin, California.

Dege, M., and L.R. Brown. 2004. Effect of outflow on spring and summer distribution and abundance of larval and juvenile fishes in the upper San Francisco Estuary. Pages 49-65 in F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi, editors. Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society, Symposium 39, Bethesda, Maryland.

Department of Fish and Game. 1999. Fall Midwater Trawl [database on the internet]. Available from http://www.delta.ca.gov/data/mwt99/index.html. Accessed on September 18, 2002.

______ 2000. 20mm Survey [database on the internet]. Available from http://www.delta.ca.gov/data/20mm/2000/. Accessed on September 18, 2002.

______ 2001. 2001 Summer Townet Survey [database on the internet]. Available from http://www.delta.dfg.ca.gov/data/skt/skt2002/index.html. Accessed on September 18, 2002.

______. 2004. Comment Letter on the Five Year Status Review of the Delta Smelt. 2 pp.

Department of Water Resources and U.S. Bureau of Reclamation, Mid-Pacific Region 1993. Effects of the Central Valley Project and State Water Project on delta smelt. Sacramento County, California. 134 pp.

______ and U.S. Bureau of Reclamation, Mid-Pacific Region 1994. Effects of the Central Valley Project and State Water Project on delta smelt and Sacramento splittail. Sacramento, California. 230 pp.

Environmental Science Associates. 2003. Stockton Delta Water Supply Project. 25 pp.

Environmental Water Account. 2003. Draft Environmental Impact Statement/Environmental Impact Report Volume III: Action Specific Implementation Plan.

Erkkila, L.F., J.F. Moffett, O.B. Cope, B.R. Smith, and R.S. Nelson. 1950. Sacramento-San Joaquin Delta fishery resources: effects of Tracy pumping plant and delta cross channel. U.S. Fish and Wildlife Services Special Report. Fisheries 56. 109 pp.

Freeport Regional Water Authority. 2003. Draft Environmental Impact Report/Environmental Impact Statement.

Ganssle, D. 1966. Fishes and decapods of San Pablo and Suisun bays. Pp.64-94 in D.W. Kelley, ed.: Ecological studies of the Sacramento-San Joaquin Estuary, Part 1. Calif. Dept. Fish and Game, Fish Bulletin No. 133.

Herbold, B. 1994. Habitat requirements of delta smelt. Interagency Ecological Studies Program Newsletter, Winter 1994. California Department of Water Resources, Sacramento, California.

Kimmerer, WJ. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? Marine Ecology Progress Serires 243:39-55.

Knutson, A.C., Jr. and J.J. Orsi. 1983. Factors regulating abundance and distribution of the shrimp *Neomysis mercedis* in the Sacramento-San Joaquin Estuary. Transactions of the American Fisheries Society 112:476-485.

Mager RC. 1996. Gametogenesis, Reproduction and Artificial Propogation of Delta Smelt, *Hypomesus transpacificus*. [Dissertation] Davis: University of California, Davis. 115 pages. Published.

Mager RC, Doroshov SI, Van Eenennaam JP, and Brown RL. 2004. Early Life Stages of Delta Smelt. American Fisheries Society Symposium 39:169-180.

Monroe, M.W. and J. Kelly 1992. State of the Estuary: A report on conditions and problems in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. San Francisco Estuary Project, Oakland, California.

Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley, California. 405 pp.

Molye, Peter B. 2002. Inland Fishes of California. University of California Press. 576 pp.

Moyle, Peter B. 2003. Comment Letter on the Five Year Status Review of the Delta Smelt. 4pp.

Moyle, P. B. and J. Cech, Jr. 1988. Fishes: An Introduction to Ichthyology. Prentice Hall, Englewood Cliffs, New Jersey. 559 pages.

Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller 1992. Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Trans. Am. Fish. Soc.121:67-77.

Nichols, F.H., J.E. Cloern, S.N. Luoma, and D.H. Peterson 1986. The modification of an Estuary. Science 231:567-573.

Nobriga, Matthew L, , Z Matica, and Z.P. Hymanson 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigaion Diversions: A Comparision among Open-Water Fishes. Pages 281-295 in F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi, editors. Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society, Symposium 39, Bethesda, Maryland.

Orsi, J.J. and W.L. Mecum. 1986. Zooplankton distribution and abundance in the Sacramento-San Joaquin Delta in relation to certain environmental factors. Estuaries 9(4B):326-339.

Poage, V. in prep 2004. Why We Do a "Post-VAMP Shoulder" for Delta Smelt. 9 pp.

Radtke, L. D. 1966. Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta. Pp. 115-119 in J. L. Turner and D. W. Kelley, eds.: Ecological studies of the Sacramento-San Joaquin Estuary, Part 2. California Department of Fish and Game Fish Bulletin No. 136.

Reclamation 1999. Contract Between the United States and Sacramento County Water Agency Providing for Project Water Service.

______.2001 Amendatory Contract Between the United States and East Bay Municipal Utility District Providing for Project Water Service From the American River Division.

______.2004. Long-Term Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment.

Sacramento County Water Agency 2002. Sacramento County Water Agency Zone 40 Water Supply Master Plan.

Souza, K. and M. Bryant. 2002. Townet Survey and Fall Midwater Trawl. Interagency Ecological Program for the San Francisco Estuary. Newsletter 15(2):21-24.

Stevens, D. E. 1996. Distribution and food habits of American Shad (*Alosa sapidissima*) in the Sacramento-San Joaquin Delta. Pp. 97-107. *In*: J.L. Turner and D.W. Kelley (Eds.). Ecological studies of the San Francisco Bay Estuary. California Fish and Game Bulletin No. 136.

Stevens, D. E. and S. W. Miller. 1983. Effects of river flow on abundance of young chinook salmon, American shad, longfin smelt, and Delta smelt in the Sacramento-San Joaquin river system. North American Journal of Fisheries Management 3:425-437.

Stevens, D. E., S. W. Miller, and B. C. Bolster 1990. Report to the Fish and Game Commission: A status review of the delta smelt (*Hypomesus transpacificus*) in California. California Department of Fish and Game Candidate Species Status Rept. 90-2. 149 pages.

Swanson, C. And J. J. Cech, Jr. 1995. Environmental tolerances and requirements of the delta smelt, Hypomesus transpacificus. Final Report. Davis, California. 77 pp.

Swanson C, Reid T, Young PS, and Cech JJ. 2000. Comparative environmental tolerances of threatened delta smelt (*Hypomesus transpacificus*) and introduced Wakasagi (*H. nipponensis*) in an altered California estuary. Oecologia 123:384- 390.

Sweetnam, D.A. 1999. Status of delta smelt in the Sacramento-San Joaquin Estuary. California Fish and Game 85(1):22-27.

Sweetnam, D.A. and D.E. Stevens 1993. Report to the Fish and Game Commission: A status review of the delta smelt (Hypomesus transpacificus) in California. Candidate Species Status Report 93-DS. Sacramento, California. 98 pages plus appendices.

Turner, J.L. and D.W. Kelly. 1966. Ecological studies of the Sacramento-San Joaquin Delta. Calif. Dept. of Fish and Game Bulletin No. 136.

U.S. Fish and Wildlife Service. 1993a. Endangered and threatened wildlife and plants: Determination of threatened status for the delta smelt. March 5, 1993. Federal Register 58(42):12854-12864.

_______. 1993b. Formal Consultation on Effects of the Proposed Los Vaqueros Reservoir Project on Delta Smelt, Contra Costa County, California

_______. 1994a. Formal Endangered Species Consultation on the Environmental Protection Agency's proposed Water Quality Standards for the San Francisco Bay/Sacramento-San Joaquin Rivers and Delta.

_______. 1994b. Endangered and threatened wildlife and plants: Critical habitat determination for the delta smelt. December 19, 1994. Federal Register 59(242): 65256-65279.

_______. 1994c. Formal consultation on the 1994 operation of the Central Valley Project and State Water Project: Effects on delta smelt. Sacramento, California. 34 pages, plus figures.

_______. 1995. Formal consultation and conference on the effects of long-term operation of the Central Valley Project and State Water Project on the threatened delta smelt, delta smelt critical habitat, and proposed threatened Sacramento splittail. Sacramento, California.52 pages, plus figures and attachment.

_______. 1996. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. Portland, Oregon.

_______. 2000. Biological Opinion on Implementation of the CVPIA and Continued Operations and Maintenance of the CVP. Sacramento, California.

_______. 2004. Five Year Status Review for the Delta Smelt. Sacramento, California. 50 pp.

Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: A guide to the early life histories. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Sacramento, California. Technical Report 9.

Wang, J.C.S. 1991. Early life stages and early life history of the delta smelt, *Hypomesus* *transpacificus*, in the Sacramento-San Joaquin Estuary, with comparison of early life stages of the longfin smelt, *Spirinchus thaleichthys*. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary. Sacramento, California.Technical Report 28.

Weihs, D. 1974. Energetic advantages of burst swimming of fish. J. Theor. Bio. 48:215-229.