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Fish Salvage at the State Water Project's and Central Valley Project's Fish Facilities during the 2012 Water Year

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Introduction

Two facilities are intended to reduce the fish loss associated with water export by the federal Central Valley Project (CVP) and California's State Water Project (SWP). The CVP's Tracy Fish Collection Facility (TFCF) and the SWP's Skinner Delta Fish Protective Facility (SDFPF) divert (salvage) fish from water exported from the southern end of the Sacramento-San Joaquin Delta. Both facilities use louver-bypass systems to remove fish from the exported water. The diverted fish are periodically loaded into tanker trucks and transported to fixed release sites in the western Delta. The TFCF began operations in 1957 and operations at the SDFPF began in 1967.

This report summarizes the 2012 water year (10/1/2011-9/30/2012) salvage information from the TFCF and the SDFPF, and discusses data from water years (WY) 1981 to 2012 for its relevance to salvage trends in recent years. The following species are given individual consideration: Chinook Salmon (*Oncorhynchus tshawytscha*), Steelhead (*O. mykiss*), Striped Bass[1] (*Morone saxatilis*), Delta Smelt[1] (*Hypomesus transpacificus*), Longfin Smelt[1] (*Spirinchus thaleichthys*), Splittail (*Pogonichthys macrolepidotus*), and Threadfin Shad[1] (*Dorosoma petenense*).

Systematic sampling was used to estimate the numbers and species of fish salvaged at both facilities. Bypass flows into the fish-collection buildings were sub-sampled generally once every 1 or 2 hours for 2.5 to 30 minutes ($\bar{x}$ = 24.9, sd = 8.8) at the SDFPF and once every 2 hours for 10 or 30 minutes ($\bar{x}$ = 29.5, sd = 17.1) at the TFCF. Fish 20 mm (fork length: FL) or larger were identified and numerated. These fish counts were expanded to estimate the total number of fish salvaged in each 1- to 2-hour period of water export. For example, a sub-sample duration of 10 minutes over a 120-minute salvage period equals an expansion factor of 12. These incremental salvage estimates were then summed across time to develop monthly and annual species-salvage totals for each facility.

Chinook Salmon loss estimates are presented because the loss model has been widely accepted and has undergone extensive field validation. Loss is the estimated number of fish entrained by the facility minus the number of fish that survive salvage operations (California Dept. of Fish and Game 2006). Salmon salvage and loss were summarized by origin (i.e., hatchery fish defined as adipose fin clipped or wild fish defined as non-adipose fin clipped) and race (fall, late-fall, winter, spring). Race of Chinook Salmon is determined solely by criteria based on length and salvage date.

Larval fish (< 20 mm FL) were also collected and examined to determine the presence of sub-20 mm Delta Smelt. Larval sampling at both facilities ran from February 16 through June 30. Larval samples were collected once for every 6 hours of water export. To retain these smaller fish, the fish screen used in the routine counts was lined with a 0.5 mm Nitex net. Larval fish from TFCF were identified to species by TFCF personnel and larval fish from SDFPF were identified to the lowest taxa by California Dept. of Fish and Wildlife personnel.

Water Exports

The SWP exported 3.25 billion m^3 of water which was a decrease from the record high export in WY 2011 (4.90 billion m^3) and comparable to WY 2010 (3.04 billion m^3) (Figure 1). The CVP exported 2.56 billion m^3 of water which was comparable to exports in WY 2008-2010, but a decrease in exports from 2011 (3.13 billion m^3) and WY 2002-2007 which ranged from 3.35 billion m^3 to 3.08 billion m^3.

The exports of the two water projects generally followed a similar seasonal pattern. Exports at the CVP reached a maximum in October-December 2011 and July -September 2012 (Figure 2). During these periods, 1.78 billion m^3 was exported by the CVP, which represented about 69.6% of annual export. Exports at the SWP reached a maximum in October and December 2011 and July-September 2012 (Figure 2). During these periods, 2.14 billion m^3 was exported by the SWP, which represented about 66.0% of annual export. CVP monthly exports ranged from 67.55 to 329.95 million m^3. SWP monthly exports ranged from 98.08 to 497.86 million m^3.

1 Pelagic Organism Decline (POD) species

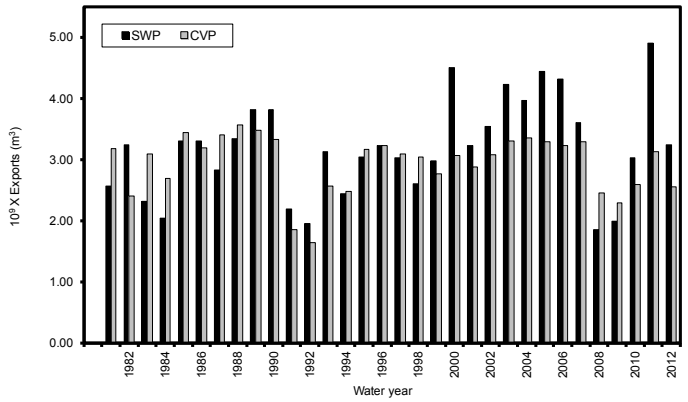

Figure 1 Annual (by water year: WY) water exports in billions of cubic meters for the SWP and the CVP, 1981 to 2012

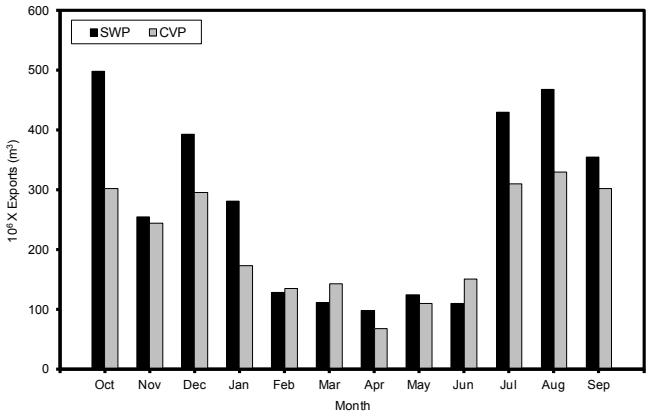

Figure 2 Monthly water exports in millions of cubic meters for the SWP and the CVP, WY 2012

Total Salvage and Prevalent Species

Annual fish salvage (all fish species combined) at the TFCF was a record low at 475,082 (Figure 3). TFCF salvage was a decrease from WY 2011 (8,724,498) and well below the record high salvage of 37,659,835 in WY 2006 (Figure 3). Annual salvage at the SDFPF was low at 1,607,286. SDFPF salvage was a decline from 2011 (3,092,553) and 2010 (2,080,353).

Striped Bass was the most-salvaged species at SDFPF while Threadfin Shad was the most-salvaged species at TFCF (Figure 4 and Table 1). American Shad (*Alosa sapidissima*) and Threadfin Shad were the 2nd and 3rd most-salvaged fish at SDFPF. Striped Bass and American Shad were the 2nd and 3rd most-salvaged fish at TFCF. Native species comprised 14.1% of annual fish salvage at SDFPF and 2.9% of annual fish salvage at TFCF. Relatively few Chinook Salmon, Steelhead, Delta Smelt, and Longfin Smelt were salvaged at the SDFPF (< 0.4% of total annual salvage combined) and the TFCF (< 0.8% of total annual salvage).

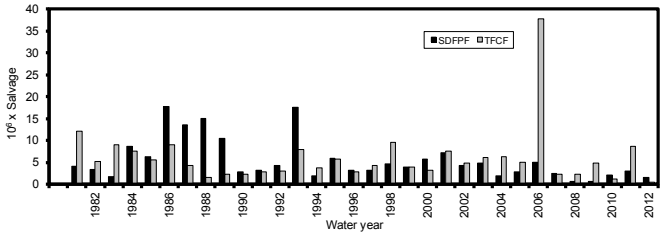

Figure 3 Annual salvage of all fish taxa combined at the SDFPF and the TFCF, WY 1981 to 2012

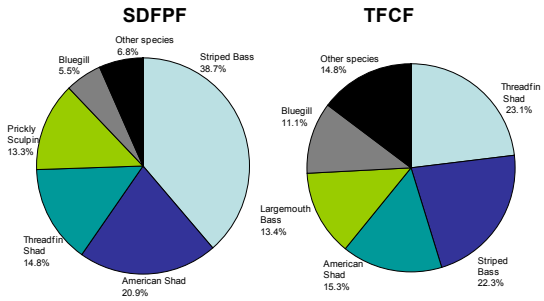

Figure 4 Percentages of annual salvage for the 5 most prevalent fish species and other fish species combined at the SDFPF and TFCF, WY 2012

Chinook Salmon

Record-low salvage (all races and origins combined) of Chinook Salmon occurred at both facilities and continued the low salvage trend since WY 2001 (Figure 5). SDFPF salvage (1,579) was a substantial decrease from WY 2011 (18,830) and a small decrease from WY 2010 levels (1,882). Mean WY 2001-2012 SDFPF salvage was about one-ninth of the mean salvages in the 1980s and the late 1990s. Salvage of Chinook Salmon at the TFCF (1,965) was substantially lower than in WY 2011 (18,135) and 2010 (7,463). Mean WY 2001-2012 TFCF salvage was about one-seventh of the mean salvages in the 1980s and the late 1990s.

Salvaged Chinook Salmon at TFCF were primarily wild spring-run and fall-run fish which comprised 70% of wild fish (Table 2). Salvaged Chinook Salmon at SDFPF were also primarily wild spring-run and fall-run fish which comprised 70% of wild fish. The majority of wild fall-run fish at the SDFPF and TFCF were salvaged in May (Figure 6).

Table 1 Annual (by water year) fish salvage and percentage of annual fish salvage (%) collected from the SDFPF and TFCF in WY 2012

SDFPF			*TFCF*		
Species	***Salvage***	***%***	***Species***	***Salvage***	***%***
Striped Bass	621,165	38.6	Threadfin Shad	109,610	23.1
American Shad	336,131	20.9	Striped Bass	105,760	22.3
Threadfin Shad	238,135	14.8	American Shad	72,603	15.3
Prickly Sculpin	213,859	13.3	Largemouth Bass	63,670	13.4
Bluegill	88,194	5.5	Bluegill	52,986	11.2
Largemouth Bass	35,171	2.2	White Catfish	29,069	6.1
Inland Silverside	28,238	1.8	Channel Catfish	10,121	2.1
White Catfish	12,430	0.8	Prickly Sculpin	8,606	1.8
Yellowfin Goby	6,543	0.4	Rainwater Killifish	6,025	1.3
Splittail	4,057	0.3	Inland Silverside	5,954	1.3
Common Carp	3,627	0.2	Chinook Salmon	1,965	0.4
Channel Catfish	3,046	0.2	Yellowfin Goby	1,755	0.4
Longfin Smelt	2,842	0.2	Golden Shiner	1,281	0.3
Bigscale Logperch	2,666	0.2	Splittail	929	0.2
Delta Smelt	1,999	0.1	Longfin Smelt	898	0.2
Black Crappie	1,940	0.1	Redear Sunfish	840	0.2
Shimofuri Goby	1,667	0.1	Black Crappie	629	0.1
Chinook Salmon	1,579	0.1	Rainbow / Steelhead Trout	493	0.1
Rainwater Killifish	1,257	0.1	Delta Smelt	355	0.1
Western Mosquitofish	888	0.1	Warmouth	318	0.1
Pacific Staghorn Sculpin	794	< 0.1	Bigscale Logperch	244	0.1
Rainbow / Steelhead Trout	443	< 0.1	Western Mosquitofish	212	< 0.1
Golden Shiner	196	< 0.1	Shimofuri Goby	162	< 0.1
Wakasagi	127	< 0.1	Common Carp	148	< 0.1
Redear Sunfish	61	< 0.1	Tule Perch	118	< 0.1
Starry Flounder	46	< 0.1	White Sturgeon	64	< 0.1
Lamprey, unknown	44	< 0.1	Brown Bullhead	54	< 0.1
Tule Perch	26	< 0.1	Threespine Stickleback	47	< 0.1
Brown Bullhead	24	< 0.1	Black Bullhead	35	< 0.1
Warmouth	18	< 0.1	Lamprey, unknown	31	< 0.1
Riffle Sculpin	17	< 0.1	Fathead Minnow	28	< 0.1
White Sturgeon	12	< 0.1	Wakasagi	24	< 0.1
Sacramento Pikeminnow	12	< 0.1	Pacific Staghorn Sculpin	17	< 0.1
Green Sunfish	8	< 0.1	Green Sunfish	13	< 0.1
Shokihaze Goby	4	< 0.1	Starry Flounder	8	< 0.1
Black Bullhead	4	< 0.1	Red Shiner	5	< 0.1
White Crappie	4	< 0.1	Sacramento Pikeminnow	4	< 0.1
Sacramento Blackfish	4	< 0.1	Hitch	1	< 0.1
Hitch	4	< 0.1			
Threespine Stickleback	4	< 0.1			

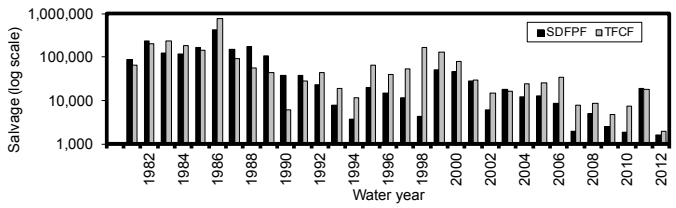

Figure 5 Annual salvage of Chinook Salmon (all races and wild and hatchery origins combined) at the SDFPF and the TFCF, WY 1981 to 2012. The Y axis is using Log_{10} logarithmic scale.

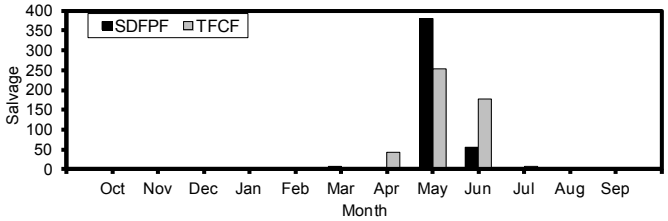

Figure 6 Monthly salvage of wild, fall-run Chinook Salmon at the SDFPF and the TFCF, WY 2012

Loss of Chinook Salmon (all origins and races) was higher at the SDFPF (6,956) than at the TFCF (1,511; Table 2). Greater entrainment loss at the SDFPF than at the TFCF was attributable to greater pre-screen loss.

Steelhead

Salvage of Steelhead (wild and hatchery origins combined) continued the pattern of mostly low salvage observed since WY 2005 (Figure 7). Salvage at the SDFPF (443) was lower than in WY 2011 (1,213). Salvage at the TFCF (493) was slightly higher than in WY 2011 (445).

The TFCF salvaged 404 hatchery Steelhead and 89 wild Steelhead. The SDFPF salvaged 200 hatchery Steelhead and 243 wild Steelhead.

Salvage of wild Steelhead at both facilities occurred in the middle of the water year (Figure 8). Wild Steelhead were salvaged most frequently in March at both the TFCF and SDFPF.

Striped Bass

Salvage at the TFCF (105,760) was a near-record low. Salvage at the TFCF and SDFPF (621,165) continued the generally-low trend observed since the mid-1990s (Figure 9). Prior to WY 1995, annual Striped Bass salvage was generally above 1,000,000 fish.

Table 2 Chinook Salmon annual salvage, percentage of annual salvage, race and origin (wild or hatchery), and loss at the SDFPF and the TFCF, WY 2012

Facility	*Origin*	*Race*	*Salvage*	*Percentage*	*Loss*
SDFPF					
	Wild				
		Fall	447	35	2,002
		Late-fall	0	0	0
		Spring	445	35	1,900
		Winter	388	30	1,702
	Total Wild		***1,280***		***5,604***
	Hatchery				
		Fall	20	7	91
		Late-fall	0	0	0
		Spring	46	15	226
		Winter	233	78	1,035
	Total Hatchery		***299***		***1,352***
	Grand Total		***1,579***		***6,956***
TFCF					
	Wild	Fall	483	31	337
		Late-fall	20	1	14
		Spring	618	39	495
		Winter	453	29	376
	Total Wild		***1,574***		***1,222***
	Unknown Race		***4***		***4***
	Hatchery				
		Fall	40	10	26
		Late-fall	24	6	20
		Spring	96	25	63
		Winter	227	59	176
	Total Hatchery		***387***		***285***
	Grand Total		***1,965***		***1,511***

* loss range is listed since actual loss could not be calculated due to a missing length (not included in grand total of loss)

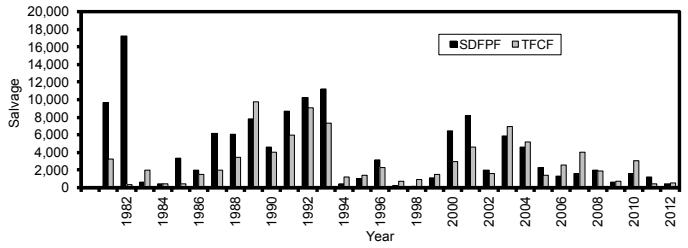

Figure 7 Annual salvage of Steelhead (wild and hatchery origins combined) at the SDFPF and the TFCF, WY 1981 to 2012

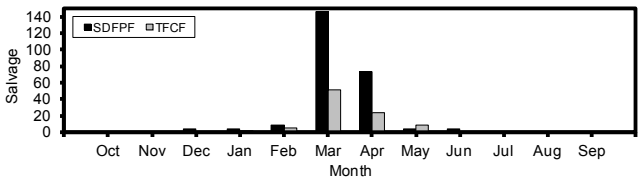

Figure 8 Monthly salvage of wild Steelhead at the SDFPF and the TFCF, WY 2012

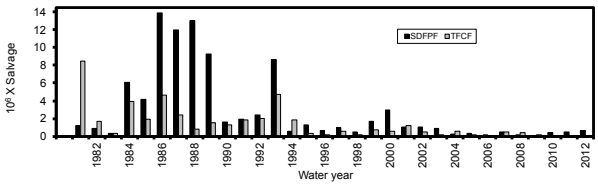

Figure 9 Annual salvage of Striped Bass at the SDFPF and the TFCF, WY 1981 to 2012

Most Striped Bass salvage at the SDFPF occurred in November 2011 and June-July, 2012. Most Striped Bass salvage at the TFCF occurred in June and July, 2012 (Figure 10). At the SDFPF, November salvage (164,579), June salvage (165,594), and July salvage (193,884) accounted for 84.4% of annual salvage. At the TFCF, salvage during June (53,999) and July (44,893) accounted for 93.5% of annual salvage. Striped Bass were salvaged every month at both facilities, with the lowest monthly salvage occurring in April at both the SDFPF (94) and the TFCF (12).

Delta Smelt

Salvage at the SDFPF (1,999) increased from WY 2011 (0) and 2010 (22), and was the highest salvage since WY 2007 (2,360) (Figure 11). Salvage at the TFCF (355) also increased from WY 2011 (51) and 2010 (99), and was the highest salvage since WY 2008 (1,009).

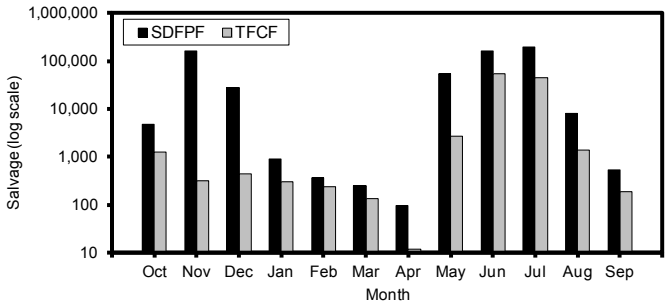

Figure 10 Monthly salvage of Striped Bass at the SDFPF and the TFCF, WY 2012. The logarithmic scale is $\log_{10}$.

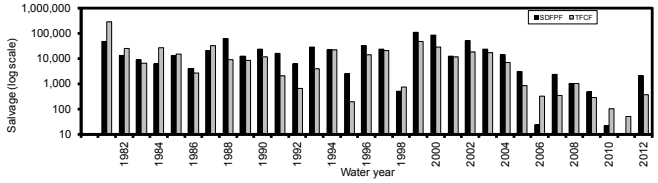

Figure 11 Annual salvage of Delta Smelt at the SDFPF and the TFCF, WY 1981 to 2012. The logarithmic scale is $\log_{10}$.

Salvage of Delta Smelt at both facilities occurred in the middle of the water year (Figure 12). Adult Delta Smelt were salvaged in February and March at the SDFPF. Juvenile Delta Smelt were salvaged in May (1,751) and June, where May salvage accounted for 87.6% of the total annual salvage. Adult Delta Smelt were salvaged January-April at the TFCF. Juvenile Delta Smelt were salvaged April-June, where May salvage (187) accounted for 52.7% of the total annual salvage.

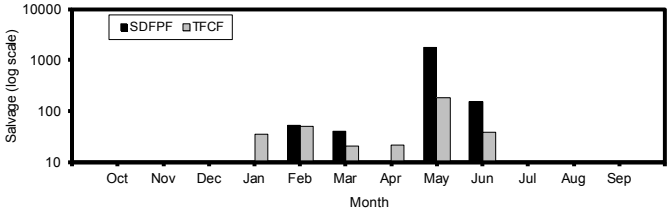

Figure 12 Monthly salvage of Delta Smelt at the SDFPF and the TFCF, WY 2012. The logarithmic scale is $\log_{10}$.

Delta Smelt less than 20 mm were first detected at the SDFPF on April 24 and were observed on 26 days of monitoring (Table 3). The longest period of consecutive daily detections was May 7-13. May was also the month with the most daily detections (14 days).

Table 3 Smelt less than 20 mm fork length (FL) observed in larval samples collected from SDFPF and TFCF in WY 2012. A "Y" indicates that Delta or Longfin Smelt < 20 mm FL were found while an "N" indicates no detection. Number of Smelt per day were recorded in parenthesis (a "Y" without a number indicates a catch of 1).

	SDFPF		*TFCF*			*SDFPF*		*TFCF*	
DATE	*Delta Smelt larvae*	*Longfin Smelt larvae*	*Delta Smelt larvae*	*Longfin Smelt larvae*	*DATE*	*Delta Smelt larvae*	*Longfin Smelt larvae*	*Delta Smelt larvae*	*Longfin Smelt larvae*
2/19	N	Y	N	N	4/29	N	N	Y (3)	Y
2/20	N	Y	N	Y	4/30	Y	N	N	N
2/21	N	Y	N	N	5/1	N	N	Y (3)	N
2/22	N	Y	N	N	5/3	Y	N	N	Y
2/24	N	Y	N	Y	5/4	Y (2)	N	Y	N
2/25	N	N	N	Y	5/5	Y	N	Y (3)	N
2/26	N	Y (2)	N	Y	5/6	N	N	Y	N
2/28	N	Y (8)	N	Y (2)	5/7	Y	N	Y (4)	N
2/29	N	Y (2)	N	Y (2)	5/8	Y (2)	N	Y	N
3/1	N	N	N	Y (4)	5/9	Y	N	Y (2)	N
3/3	N	Y (2)	N	Y	5/10	Y (8)	N	Y	N
3/5	N	Y (4)	N	Y (5)	5/11	Y (8)	N	Y (4)	N
3/6	N	N	N	Y (18)	5/12	Y (5)	N	N	N
3/7	N	Y (7)	N	N	5/13	Y	N	N	N
3/8	N	N	N	Y (2)	5/14	N	N	Y	N
3/9	N	N	N	Y	5/15	N	N	Y	N
3/10	N	Y (3)	N	Y (2)	5/18	N	N	Y	N
3/11	N	Y (19)	N	Y (5)	5/20	Y (7)	N	Y	N
3/12	N	Y (2)	N	Y	5/21	Y	N	N	N
3/13	N	Y (17)	N	Y	5/22	N	N	Y	N
3/14	N	Y (11)	N	Y (4)	5/23	Y	N	Y	N
3/15	N	Y (11)	N	N	5/24	N	N	Y (2)	N
3/16	N	Y (6)	N	Y	5/25	Y	N	Y (4)	N
3/17	N	Y	N	N	5/26	N	N	Y	N
3/19	N	Y (2)	N	N	5/27	N	N	Y (4)	N
3/20	N	Y	N	N	5/29	N	N	Y	N
3/21	N	Y (21)	N	Y	5/30	N	N	Y (5)	N
3/22	N	Y (2)	N	Y (5)	5/31	N	N	Y (8)	N
3/24	N	Y (3)	N	N	6/1	Y (5)	N	Y (6)	N
3/25	N	Y (6)	N	N	6/2	Y (1)	N	Y (4)	N
3/26	N	Y	N	N	6/3	N	N	Y (12)	N
3/27	N	N	N	Y (2)	6/4	Y (3)	N	N	N
3/28	N	Y	N	N	6/5	Y (5)	N	Y (8)	N
3/31	N	N	N	Y (2)	6/6	N	N	Y (7)	N
4/2	N	Y	N	N	6/7	Y	N	Y (4)	N
4/5	N	Y	N	N	6/8	N	N	Y	N
4/9	N	N	N	Y	6/9	N	N	Y	N
4/10	N	N	N	Y	6/10	N	N	Y (2)	N
4/12	N	N	N	Y (6)	6/11	N	N	Y (3)	N
4/13	N	N	N	Y	6/12	Y (2)	N	Y	N
4/15	N	N	N	Y	6/13	Y (5)	N	Y	N
4/16	N	N	N	Y	6/14	Y	N	Y	N
4/24	Y (3)	N	N	N	6/16	N	N	Y	N
4/25	Y (4)	N	N	N	6/18	Y	N	Y (3)	N
4/26	N	N	Y (3)	N	6/22	N	N	Y	N
4/28	N	N	Y	Y	6/25	N	N	Y	N

Delta Smelt less than 20 mm were first detected at the TFCF on April 26 and were observed on 42 days of monitoring (Table 3). The longest period of consecutive daily detections was June 5-14. May was the month with the most daily detections (22 days).

Longfin Smelt

Salvage at the SDFPF (2,842) increased substantially from WY 2011 (0) and 2010 (4), and was the highest recorded salvage since WY 2002 (54,594) (Figure 13). Salvage at the TFCF (898) also increased from WY 2011 (4) and 2010 (31), and was the highest recorded salvage since WY 2003 (4,598).

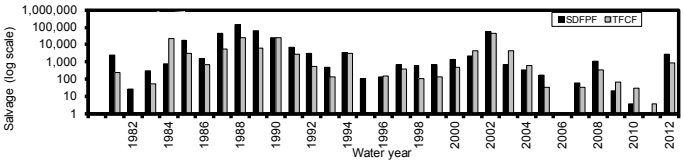

Figure 13 Annual salvage of Longfin Smelt at the SDFPF and the TFCF, WY 1981 to 2012. The logarithmic scale is $\log_{10}$.

Longfin Smelt were salvaged March-May at the SDFPF (Figure 14). March salvage (1,568) accounted for 55.2% of the total annual salvage. Longfin Smelt were salvaged February-May at the TFCF. April salvage (635) accounted for 70.7% of the total annual salvage.

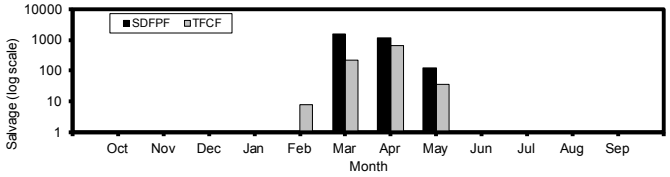

Figure 14 Monthly salvage of Longfin Smelt at the SDFPF and the TFCF, WY 2012. The logarithmic scale is $\log_{10}$.

Longfin Smelt less than 20 mm were first detected at the SDFPF on February 19 and were observed on 31 days of monitoring (Table 3). The longest period of consecutive daily detections was March 10-17. March was also the month with the most daily detections (19 days).

Longfin Smelt less than 20 mm were first detected at the TFCF on February 20 and were observed on 31 days of monitoring (Table 3). The longest period of consecutive daily detections was March 8-14. The month with the most daily detections was March (16 days).

Splittail

Salvage of Splittail at both facilities was lower than in WY 2011 (Figure 15). Salvage at the SDFPF (4,057) was much lower than in WY 2011 (1,326,065). Salvage was a near-record low at the TFCF (929) which was substantially lower than the record high in WY 2011 (7,660,024). Splittail salvage has followed a boom-or-bust pattern, often varying year to year by several orders of magnitude.

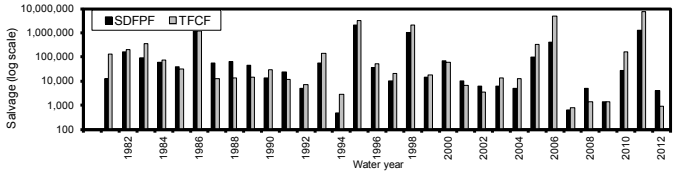

Figure 15 Annual salvage of Splittail at the SDFPF and the TFCF, WY 1981 to 2012. The logarithmic scale is $\log_{10}$.

Threadfin Shad

Annual salvage at the SDFPF (238,135) was higher than at the TFCF (109,610) (Figure 16). Salvage at the SDFPF was lower than in WY 2011 (463,610). Similarly, TFCF salvage in WY 2012 was much lower than in WY 2011 (591,111) and was a record low. Similar to Splittail, annual salvage of Threadfin Shad has varied greatly through time.

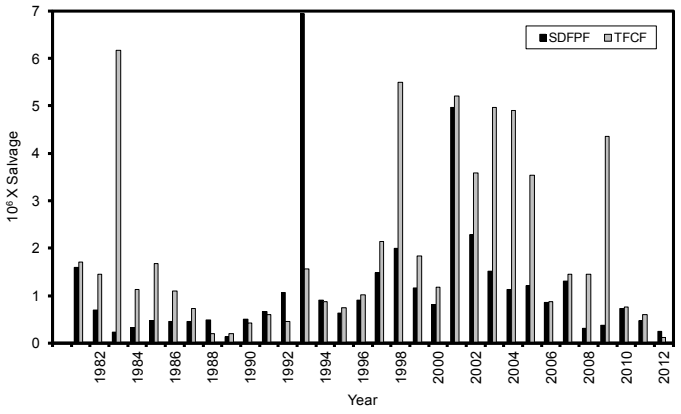

Figure 16 Annual salvage of Threadfin Shad at the SDFPF and the TFCF, WY 1981 to 2012

References

California Dept. of Fish and Game. 2006. Chinook salmon loss estimation for Skinner Delta Fish Protective Facility and Tracy Fish Collection Facility. Protocol. Stockton: California Dept. of Fish and Game; p. 4. Available from the California Dept. of Fish and Wildlife (formerly Fish and Game), Bay-Delta Region East, 2109 Arch-Airport Rd, Suite 100, Stockton, CA 95206

Central Valley Chinook Salmon Harvest and Escapement

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This paper presents the available Chinook Salmon escapement and harvest estimates, with a focus on the California Central Valley escapement. The available estimates are compared to estimates from earlier years and the data are plotted. The data were collected from the PFMC Annual Fisheries Review, biologists throughout the Sacramento and San Joaquin River systems, and from the GrandTab database output.

California Ocean Harvest

The estimated harvest in California ocean waters was 337,663 Chinook Salmon in 2012 (PFMC 2013). This is the highest since 2005, but only 61% of the 40 year average ocean harvest of 555,780 (Figure 1).

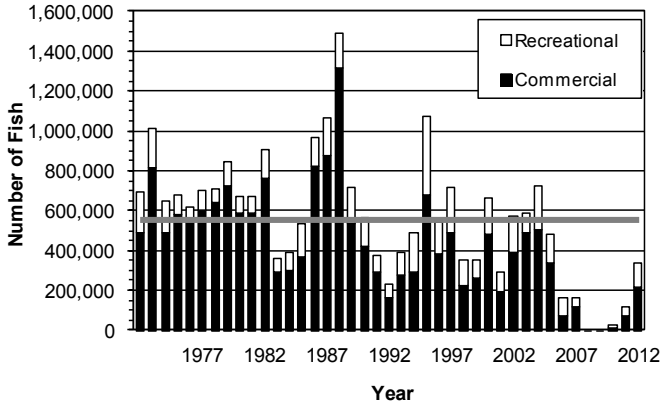

Figure 1 California commercial and recreational Chinook Salmon ocean catch from 1973 to 2012 and 40 year average (gray line)

California Central Valley Harvest

The estimated harvest in Central Valley waters was 83,145 Chinook Salmon in 2012, 1.3 times the harvest of 62,230 in 2011. The harvest of late-fall run was 930 in 2012, 54% less than the 1,730 in 2011. There was no winter run harvest in 2012, continuing the trend starting in 2010. The harvest of spring-run was 708 in 2012, about five times the 140 in 2011. The harvest of Sacramento fall-run was 76,628 in 2012, 32% more than the 57,833 in 2011. The harvest of San Joaquin fall-run was 4,869 in 2012, about 2 times the 2,183 Chinook Salmon in 2011.

California Central Valley Escapement

The California Central Valley contains the Sacramento and San Joaquin River systems. The Sacramento River System is made up of the mainstem Sacramento River and the many tributaries that flow into it. Likewise, the San Joaquin River also has many tributaries. Each year, escapement estimates are made for Chinook Salmon that return to spawn in natural areas and for those that return to hatcheries within these river systems. These estimates are in addition to the inland harvest estimates.

In 2012, the escapement estimate for Chinook Salmon returning to hatcheries and natural areas of California's Central Valley was 372,766 fish (Azat 2013). This is the highest since 2005, and 120% of the 40 year average of 311,497 (Figure 2). The late-fall-run escapement was 12,305, the winter-run escapement was 7,182, the spring-run escapement was 17,207, and the fall-run escapement was 341,759 Chinook Salmon. While escapement increased in 2012 compared to 2011 for most runs, late-fall estimates continued to decline.

Late-fall-run Escapement to the Sacramento River System

The estimated escapement of late-fall-run Chinook Salmon to the Sacramento River and its tributaries was 5,991 in 2012, the lowest on record since 1997 and 49% of the 40 year average of 12,305 (Figure 3). Escapement to the Sacramento River was 2,869. Escapement to Battle Creek was 3,045. Most of the late-fall run in Battle Creek were counted at Coleman National Fish Hatchery, where the fish are propagated.