Fish Salvage at the Tracy Fish Collection Facility during the 2016 Water Year

by

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Introduction

The Tracy Fish Collection Facility (TFCF) diverts (salvages) some fish from water exported from the southern portion of the Sacramento-San Joaquin Delta. The fish are loaded into tanker trucks, trucked to release sites away from the immediate influence of the export pumps, and released into the western Delta. This report summarizes the 2016 water year (10/1/2015-9/30/2016) operational and biological information gathered from the TFCF. 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*).

Methods

Daily volumes of water exported were reported from gauge readings at the C.W. "Bill" Jones Pumping Plant in Byron. Monthly water exports were plotted and examined for time trends. Water year (WY) exports for the Central Valley Project (CVP) from 1981 through 2016 were noted. Salvage data from WYs 1981 to 2016 were examined for long and short-term trends.

Fish abundance was reported as "estimated salvage". Only fish ≥ 20 mm FL were numerated (counts), because salvage efficiency degrades rapidly for fish smaller than that size. Salvage estimates were primarily obtained by multiplying routine sample counts by an expansion factor calculated as salvage minutes divided by minutes of the sample count:

$$SALVAGE_{SAMPLE} = COUNT_{SAMPLE} \mathbf{x} (SALVAGE\ MINUTES / MINUTES_{SAMPLE}). \quad (1)$$

Fish collected during predator removals were not expanded:

$$SALVAGE_{PREDATOR\ REMOVAL/SECONDARY\ FLUSH} = COUNT_{PREDATOR\ REMOVAL/SECONDARY\ FLUSH.} \quad (2)$$

Salvage estimates were calculated by the summation of Equations 1 and 2 by month or WY. Intra-annual abundances were examined by plotting the monthly salvage totals for selected fish species and for all fish taxa combined for WY 2016.

The annual and monthly salvage estimates for Chinook Salmon and Steelhead were calculated for wild and hatchery fish. Salmonid origin was determined by the presence (assumed to be wild) or absence (assumed to be hatchery) of an adipose fin. Race of Chinook Salmon was determined solely by the Delta criteria based on length at date of salvage (California Dept. of Fish and Wildlife 2014).

Chinook Salmon loss estimates are presented because its loss model has been widely accepted and has undergone extensive review. Loss is the estimated number of fish encountered by the facility minus the number of fish that survive salvage operations. Loss was subcategorized by origin and race.

Larval fish sampling was conducted during March 1 through June 7 to detect the presence of Delta Smelt and Longfin Smelt larvae and post-larval juveniles (<20 mm

FL). The fish screen used in regular fish counts was lined with a 0.5-mm Nitex net in order to retain smaller fish. Larval sampling was conducted at 0400, 1000, 1600, and 2200 hours. Larval fish were identified to species by TFCF personnel and reported the next working day.

Water Exports

The CVP exported 1,360,026 acre feet (AF) of water which was a marked increase and represented a 195.5% increase from the record low in WY 2015 (695,650 AF) (Figure 1). Still, the annual exports in WYs 2014-2016 were a marked decrease to WYs 2008-2013 which ranged from 1,844,493 to 2,539,025 AF. Although WY 2016 was a below normal (Sacramento Water Supply) to dry year (San Joaquin Water Supply), the increase in export in WY 2016 coincided with increased rainfall following four years of drought conditions in California.

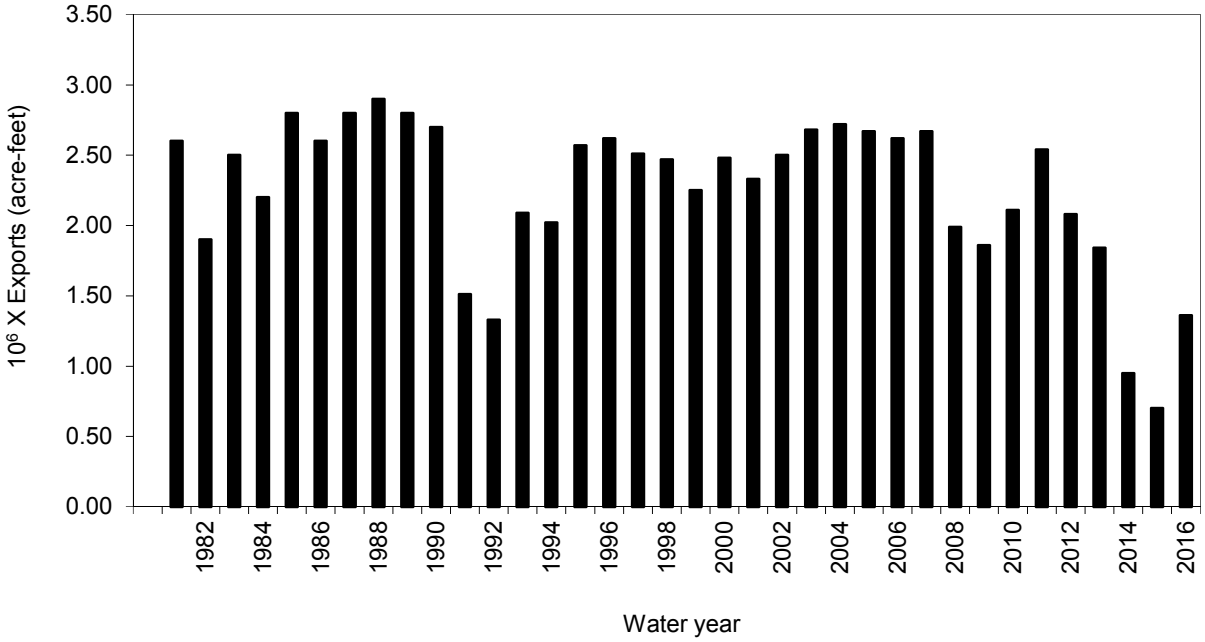

Figure 1 Annual exports (by water year; WY) in millions of acre-feet for the Central Valley Project, WYs 1981–2016

The majority of water exports occurred in January-March and August-September (Figure 2). During these periods, a total of 889,775 AF was exported, accounting for 65.4% of the total export. The high exports in January-March differed from past years where January-March exports were generally lower than summer and fall months. Winter exports are generally dependent on monthly rainfall and available water for export. Monthly exports ranged from 59,176 to 227,324 AF. Combined exports for April-June were 189,219 AF which fell within the middle range for the same period during WYs 2004-2015 (97,312-439,833 AF).

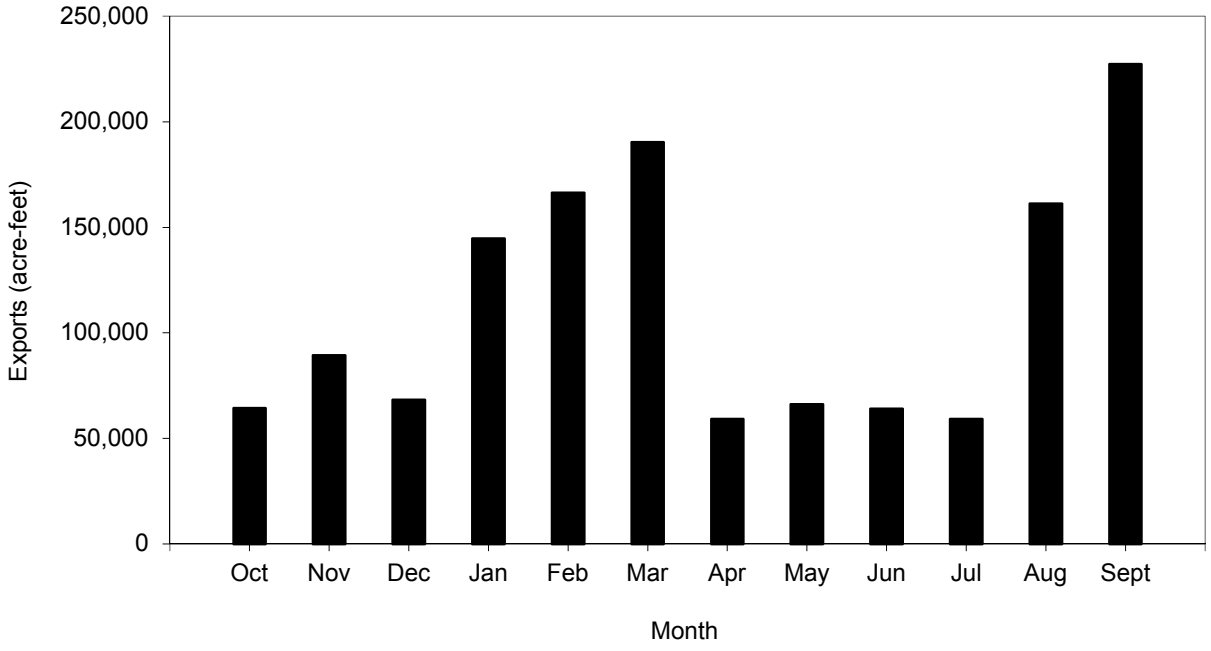

Figure 2 Monthly exports (in acre-feet) for the Central Valley Project, WY 2016

Total Salvage and Prevalent Species

Total fish salvage (all fish combined) at the TFCF was low at 1,437,551 (Figure 3). This total was an increase from the low salvage in WY 2015 (295,854) and the record low

salvage in WY 2014 (160,681). The 2016 total was well below the record high salvage of 37,659,835 in WY 2006. The increase in total fish salvage from WYs 2014-2015 was most likely affected by an increase in exports since salvage in recent years has been influenced by exports (i.e. increased salvage at high exports).

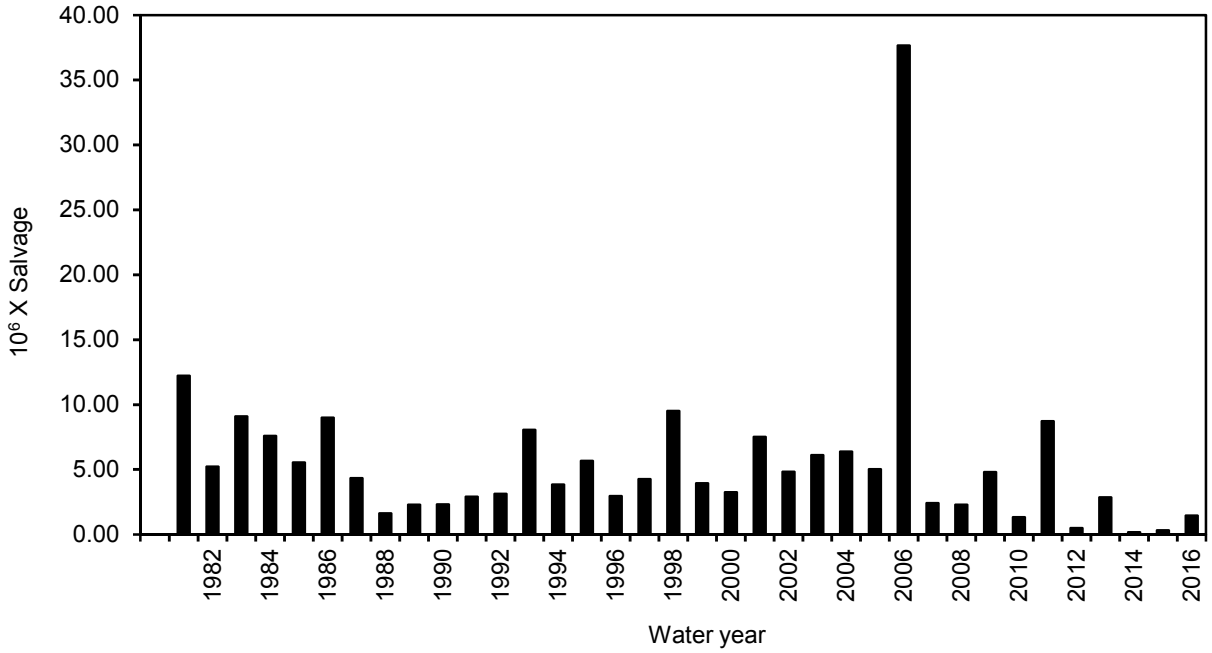

Figure 3 Annual salvage (by water year, WY; in millions) of all fish taxa combined at the TFCF, WYs 1981–2016

Threadfin Shad accounted for 78.5% of the total salvage (Figure 4 and Appendix A). Threadfin Shad usually makes up the bulk of salvage in most years, but an exception was when Common Carp accounted for 81.8% (30,495,481) of salvage in WY 2006. The 2nd to 5th most salvaged species were Bluegill (9.1%), Striped Bass (4.3%), Largemouth Bass (3.3%), and White Catfish (1.1%). The Striped Bass contribution to total salvage decreased compared to WY 2015 (7.2%), increased compared to WY 2014 (3.7%), but decreased substantially compared to WY 2012 (22.3%). Native

species comprised 0.7% of total fish salvage. Chinook Salmon, Steelhead, Delta Smelt, and Longfin Smelt accounted for 0.1% of salvage.

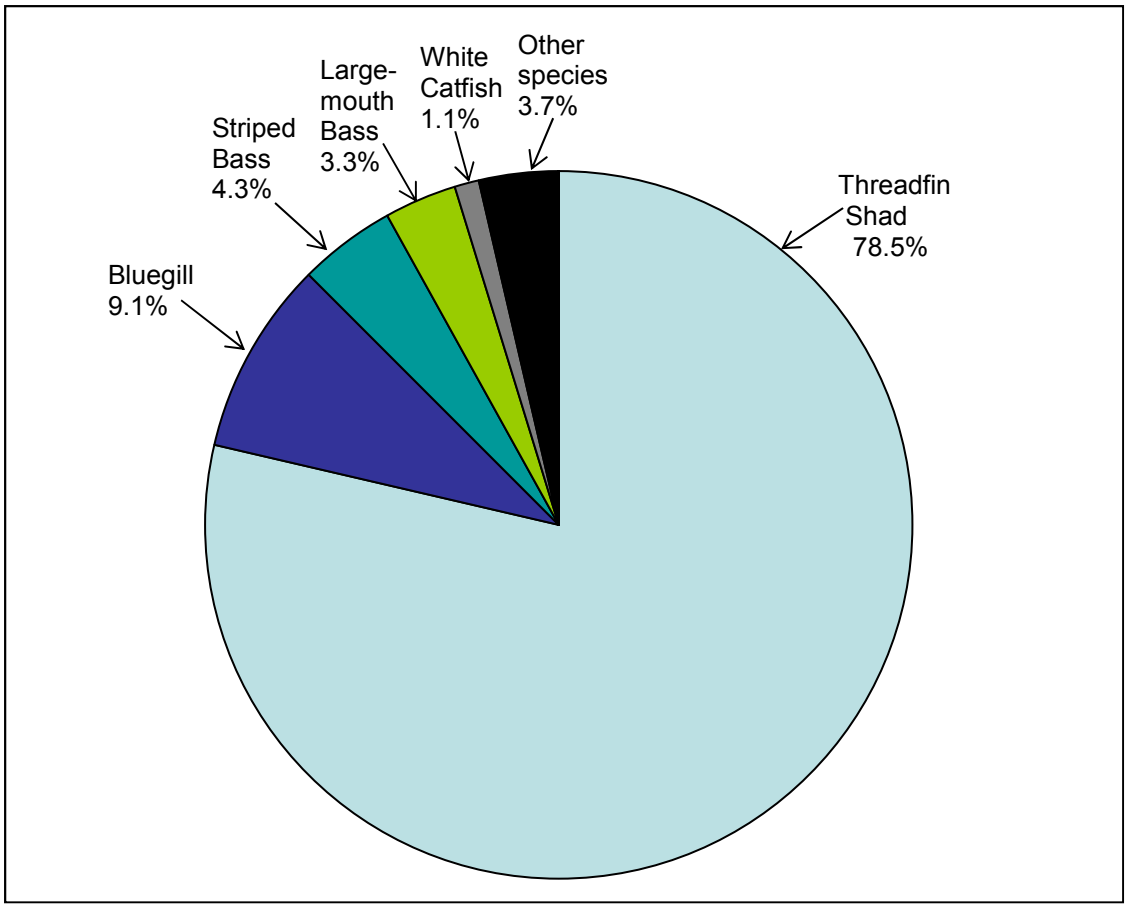

Figure 4 Percentages of annual salvage for the 5 most-prevalent species and other species combined at the TFCF, WY 2016

Chinook Salmon

The annual salvage of 970 juvenile Chinook Salmon (all races and origins combined) continued the low salvage trend since WY 2001 (Figure 5). Salvage of Chinook Salmon in WY 2016 was a marked increase from the record low in WY 2015 (187), but a

decrease from WY 2014 (1,177). Mean salvage for WYs 2001-2016 was only 10.3% of the mean salvage for WYs 1981-2000.

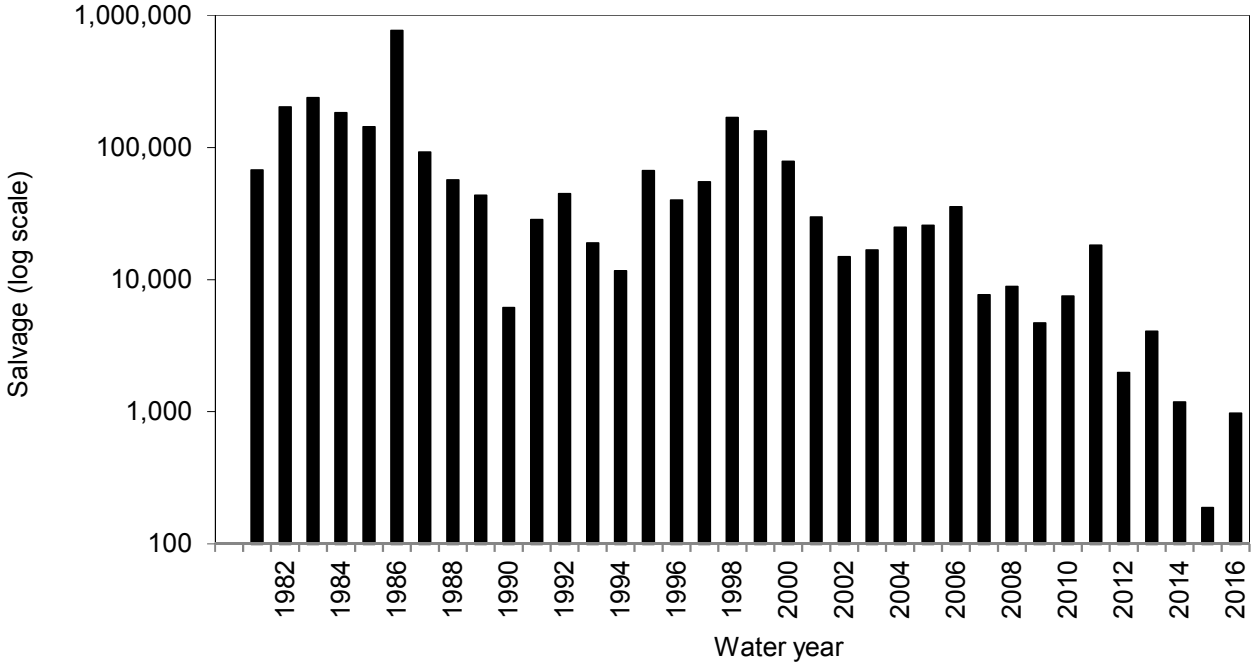

Figure 5 Annual salvage of Chinook Salmon (all races and origins combined) at the TFCF, WYs 1981–2016

Wild Chinook Salmon consisted primarily of spring run sized fish (47.3%) followed by fall run sized fish (35.1%, Table 1). Wild spring run fish were salvaged in February-May while fall run fish were salvaged in January-March and May (Figure 6). The majority of wild spring run fish (33.3%) were salvaged in March and the majority of wild fall run fish (90.0%) were salvaged equally in January-March. The estimated loss of Chinook Salmon was 680 (Table 1).

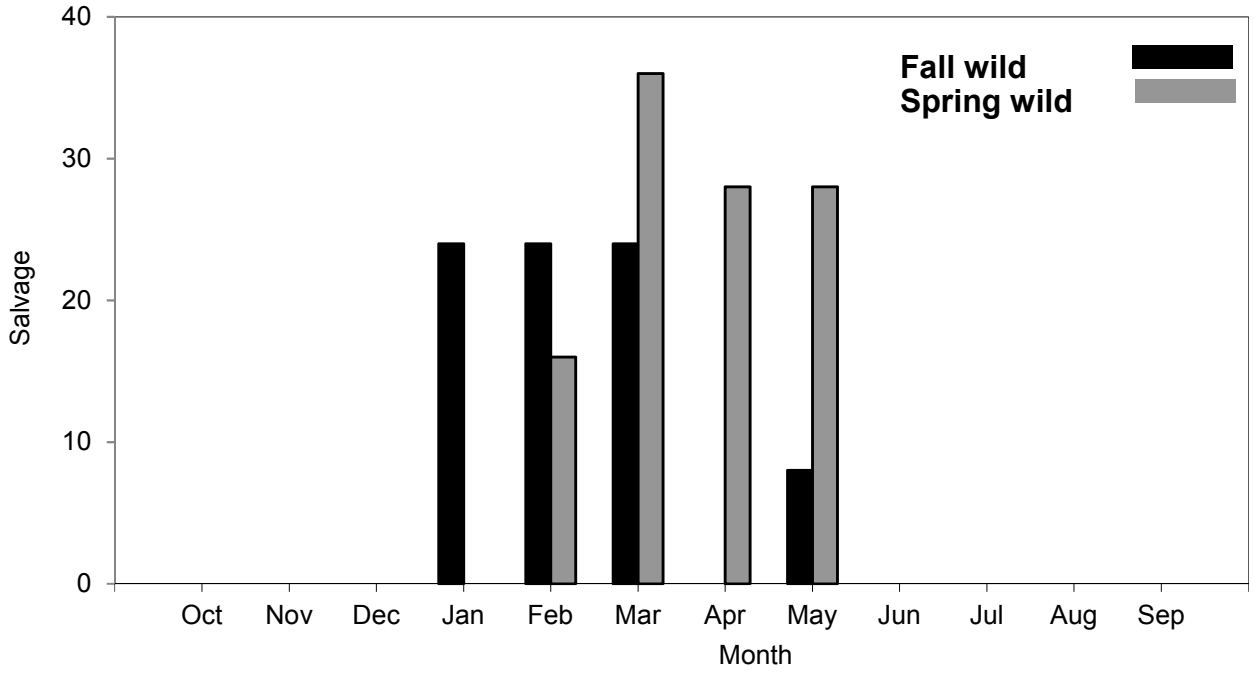

Figure 6 Monthly salvage of wild spring and fall run Chinook Salmon at the TFCF, WY 2016

Table 1 Chinook Salmon annual salvage, percentages of annual salvage, and losses at the TFCF, WY 2016, by race and origin (wild or hatchery)

Origin	Race	Salvage	Percentage	Loss
Wild	Fall	80	35.1	57
	Late-fall	8	3.6	7
	Spring	108	47.3	83
	Winter	28	12.3	21
	Unknown Race	4	1.7	*
Total Wild		**228**		**168**
Hatchery	Fall	4	0.6	3
	Late-fall	32	4.3	26
	Spring	616	83.0	413
	Winter	90	12.1	70
Total Hatchery		**742**		**512**
Grand Total		***970***		***680***

* No loss was calculated for sub-adult unknown run Chinook Salmon (n=1)

Steelhead

Salvage of wild and hatchery Steelhead (652) increased from the record low in WY 2015 (124) and continued the pattern of mostly low salvage observed since WY 2005 (Figure 7). Salvage also increased from WY 2014 (330).

Juvenile Steelhead salvage estimates were primarily of hatchery origin. The salvage composition was 591 hatchery and 61 wild fish.

Salvage of Steelhead occurred in the middle of the water year. Hatchery Steelhead were salvaged January-June while wild Steelhead were salvaged January-April (Figure 8). Hatchery and wild Steelhead were both salvaged most frequently in February-March.

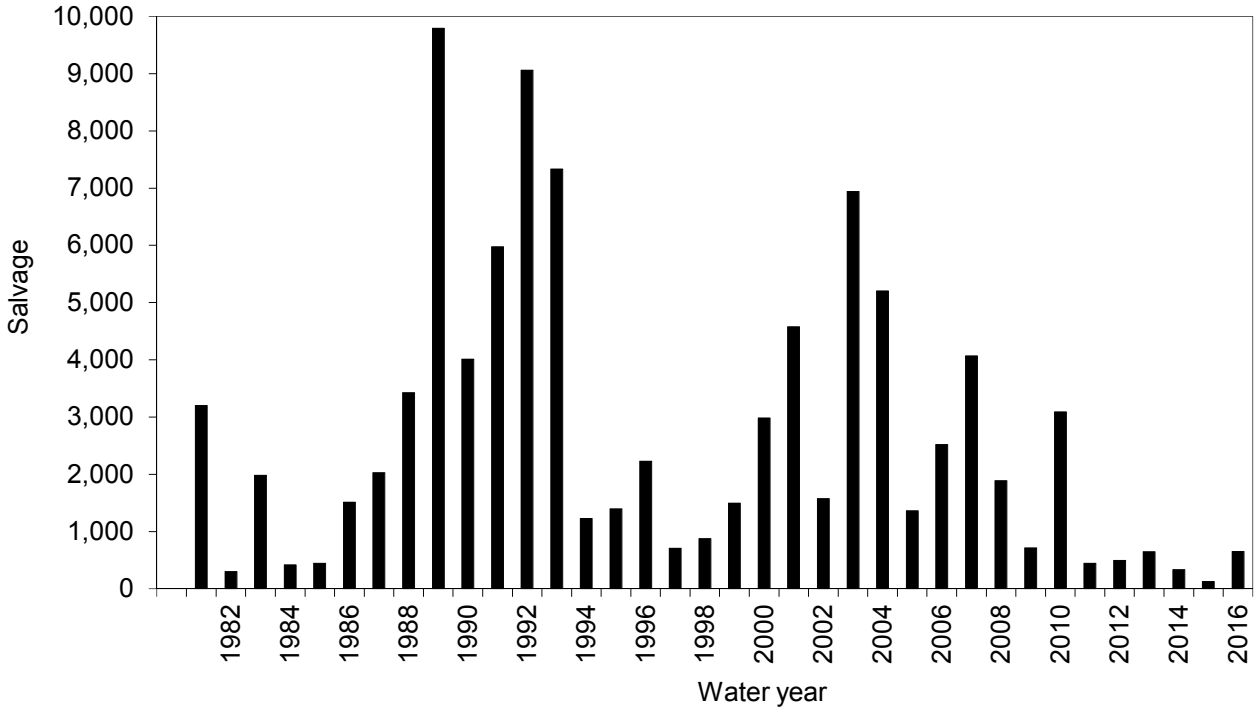

Figure 7 Annual salvage of Steelhead (all origins combined) at the TFCF, WYs 1981–2016

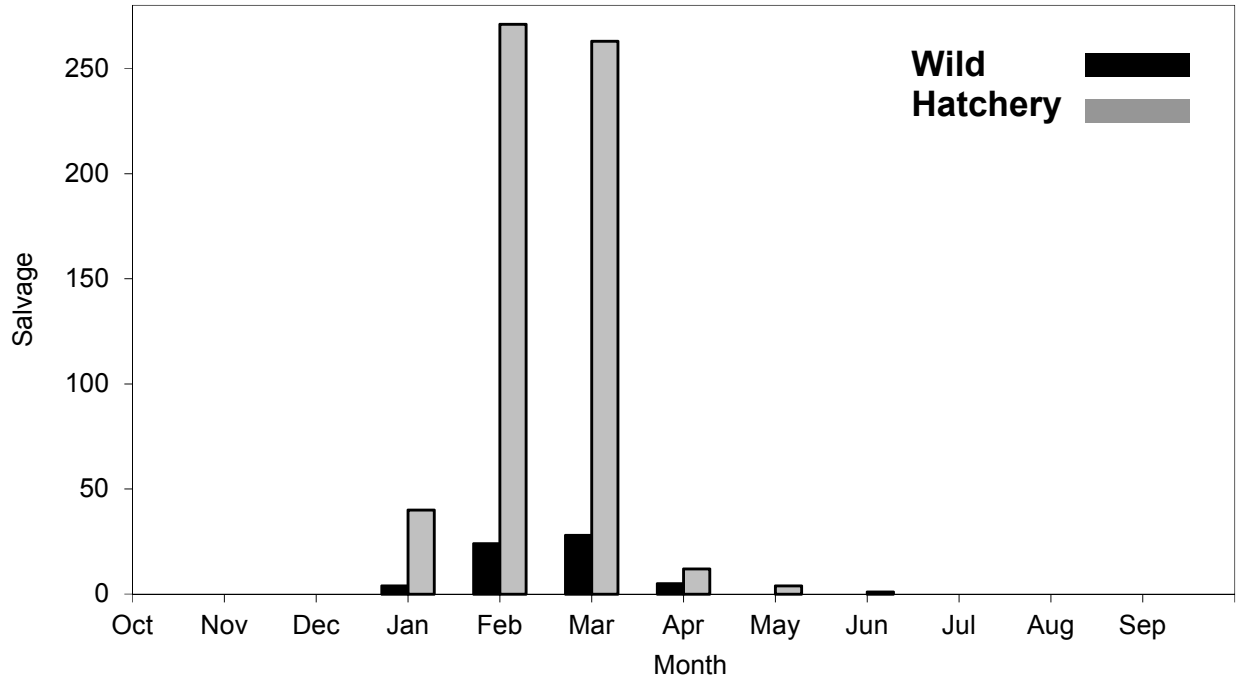

Figure 8 Monthly salvage of hatchery and wild Steelhead at the TFCF, WY 2016

Striped Bass

The annual salvage of 61,787 Striped Bass continued the low salvage trend observed since WY 1995 (Figure 9). Prior to WY 1995 and except for WY 1983 and WY 1988, annual Striped Bass salvages were above 1,000,000.

Most Striped Bass were salvaged in May-June (Figure 10). The May salvage (9,463) and June salvage (29,894) accounted for 63.7% of the total salvage. Striped Bass were salvaged every month and the lowest salvage occurred in October (48).

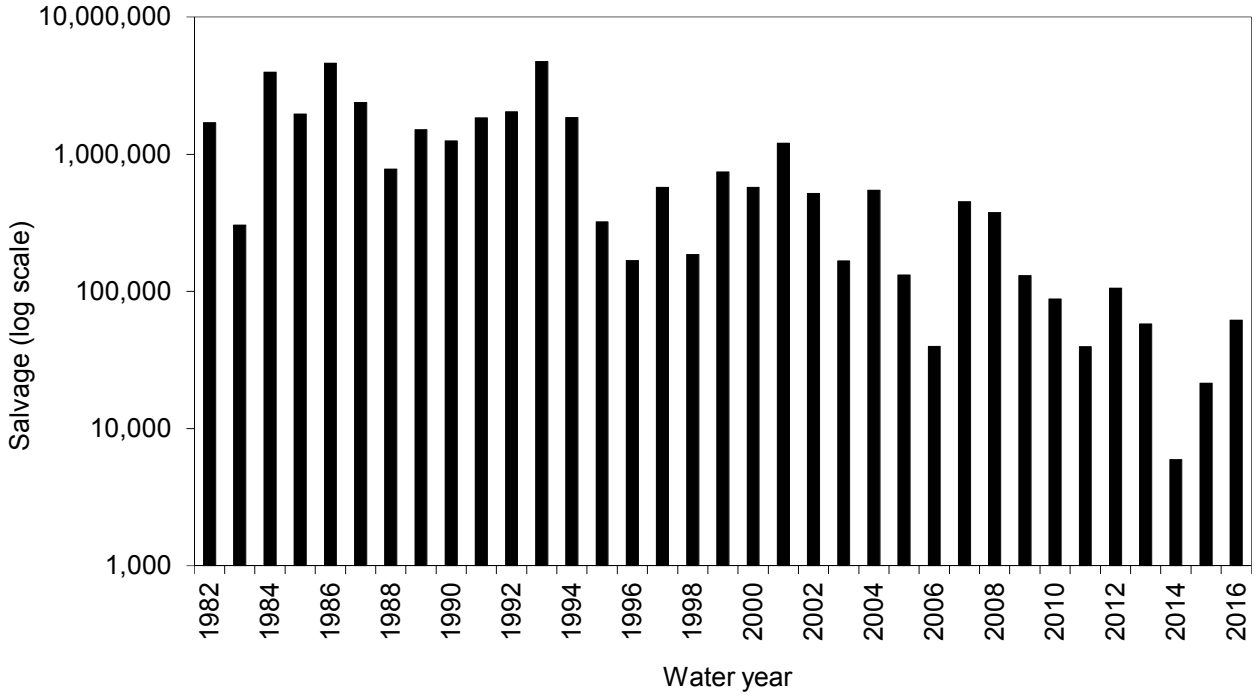

Figure 9 Annual salvage of Striped Bass at the TFCF, WYs 1981–2016

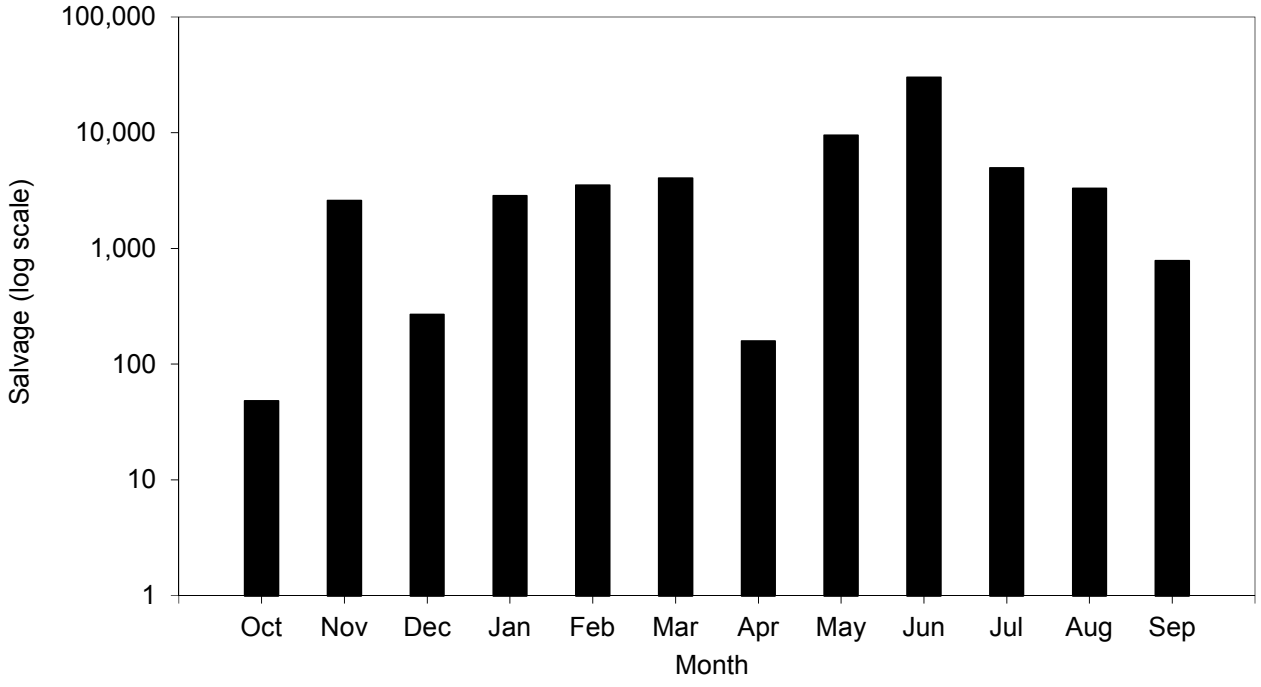

Figure 10 Monthly salvage of Striped Bass at the TFCF, WY 2016

Delta Smelt

Salvage of Delta Smelt (12) was a record low and a decrease from WY 2015 (68) and WY 2014 (16), and a marked decrease from WY 2013 (300) (Figure 11). WYs 2005-2016 was the lowest 12-year period of annual salvage on record (12-1,009).

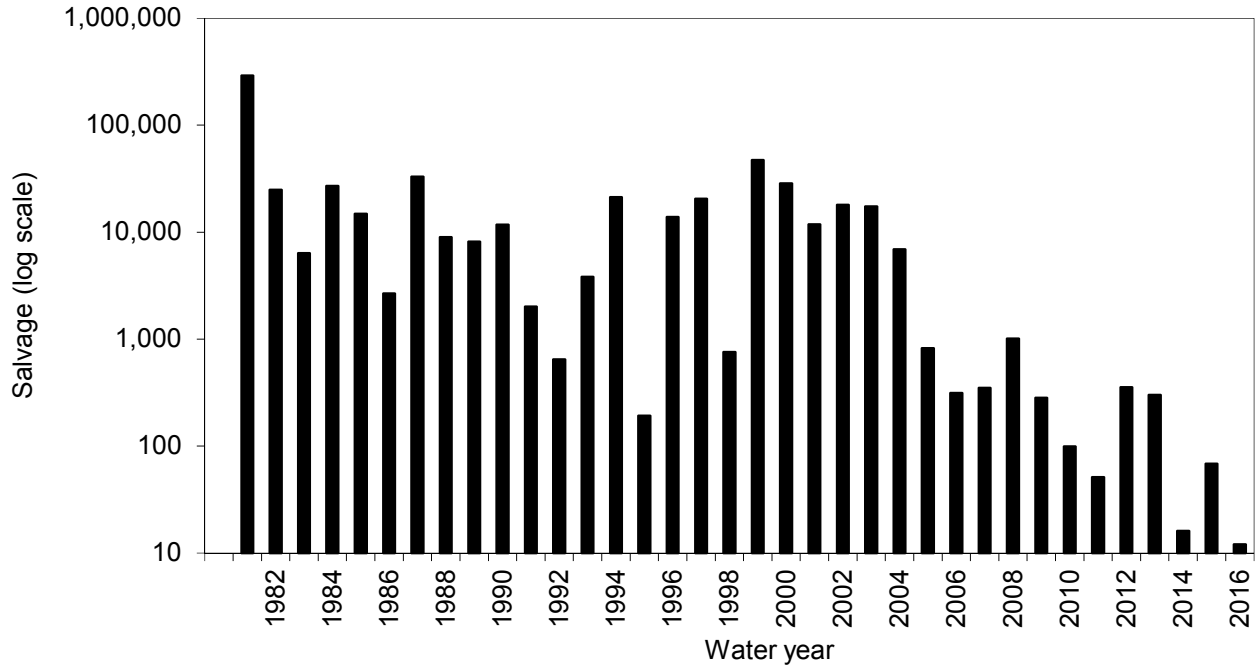

Figure 11 Annual salvage of Delta Smelt at the TFCF, WYs 1981–2016

Adult Delta Smelt were salvaged equally between January (4) and February (4) which accounted for 66.7% of the total WY salvage. Juvenile Delta Smelt at TFCF were only salvaged in April (4).

No Delta Smelt less than 20 mm FL were detected in WY 2016, as in WY 2015, which was a decrease from WY 2014 (6).

Longfin Smelt

No adult Longfin Smelt and only eight juvenile Longfin Smelt were salvaged in March. The annual salvage of Longfin Smelt was equal to WY 2014 (8), but decreased from WY 2015 (28) and markedly from WY 2013 (241). Low annual salvages have generally been observed since 1991, with the exception of 43,056 salvaged in WY 2002 (Figure 12).

Only one Longfin Smelt less than 20 mm FL was detected on March 16th which was a decrease from WYs 2015 (5) and 2014 (2).

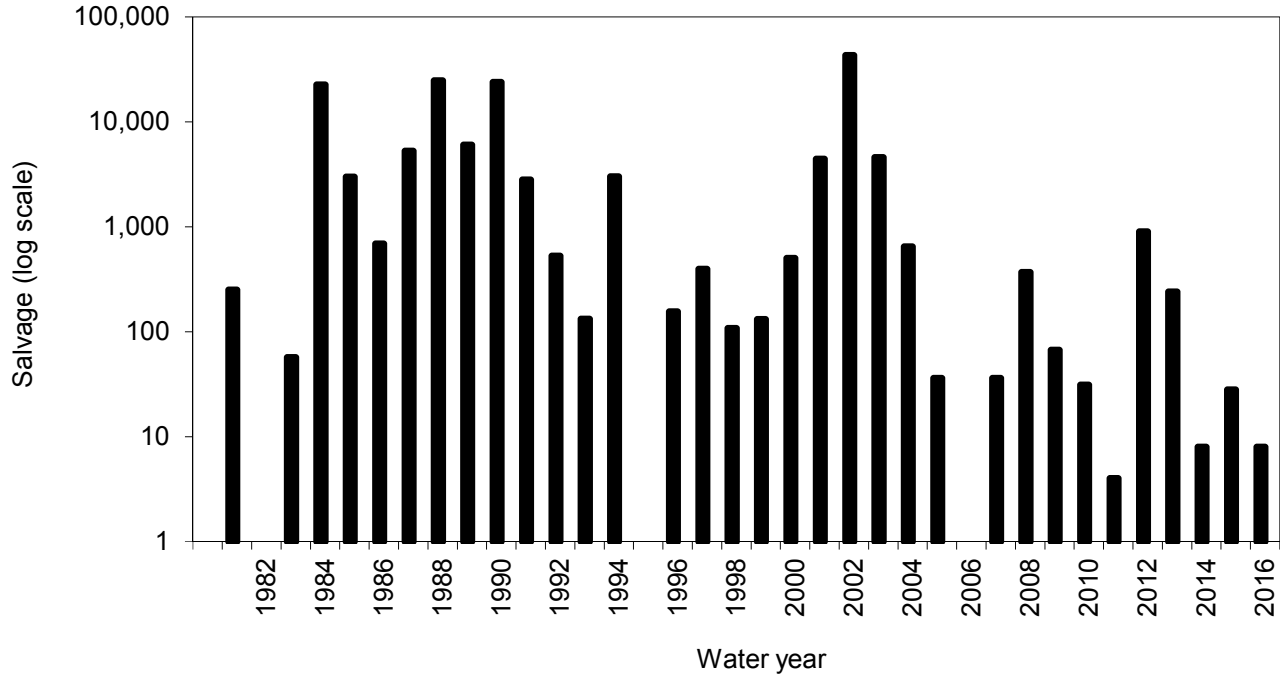

Figure 12 Annual salvage of Longfin Smelt at the TFCF, WYs 1981–2016

Splittail

The salvage of Splittail (109) was an increase from the record lows in WYs 2015 (12) and 2014 (12), but markedly 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 13). High Splittail salvage is generally associated with wet years.

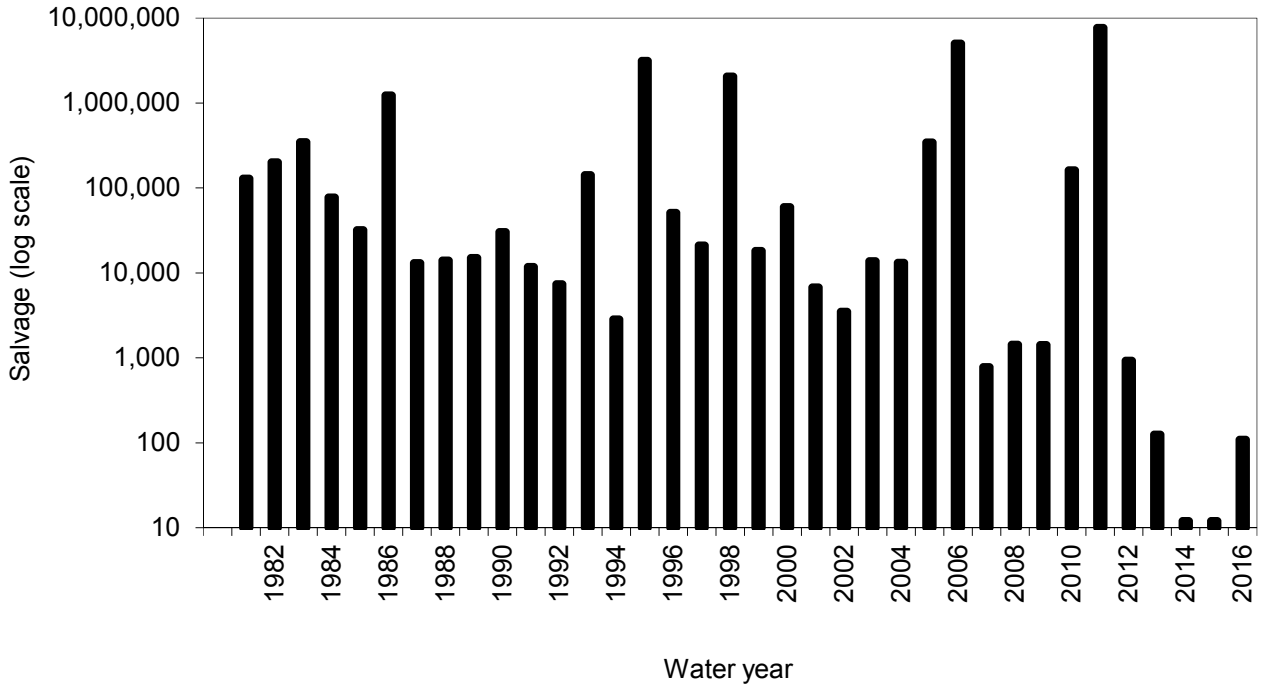

Figure 13 Annual salvage of Splittail at the TFCF, WYs 1981–2016

Threadfin Shad

The near record low salvage of juvenile and adult Threadfin Shad (1,127,956) was a marked increase from the record low in WY 2015 (114,804), but a substantial decrease from WY 2013 (2,463,695). Similar to Splittail, annual salvages of Threadfin Shad have

varied greatly through time (Figure 14). Prior to WY 2005, WYs 2001-2004 was the highest 4 year period of annual salvage on record (3.6-5.2 million).

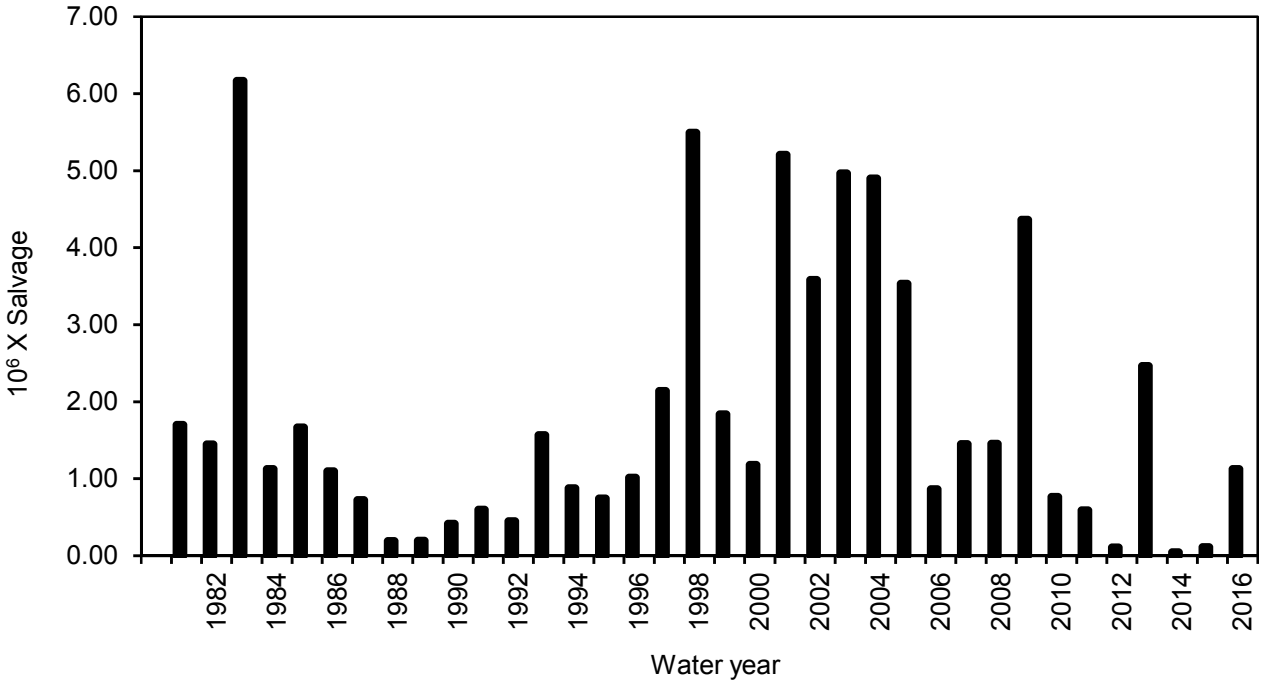

Figure 14 Annual salvage (in millions) of Threadfin Shad at the TFCF, WYs 1981–2016

Threadfin Shad salvage in WY 2016 followed the same trend as observed in past years. Adult Threadfin Shad were mostly salvaged in fall, winter, and early spring. Juvenile Threadfin Shad were mostly salvaged in summer and fall where July-August salvage (913,671) accounted for 81.0% of the total WY salvage (Figure 15).

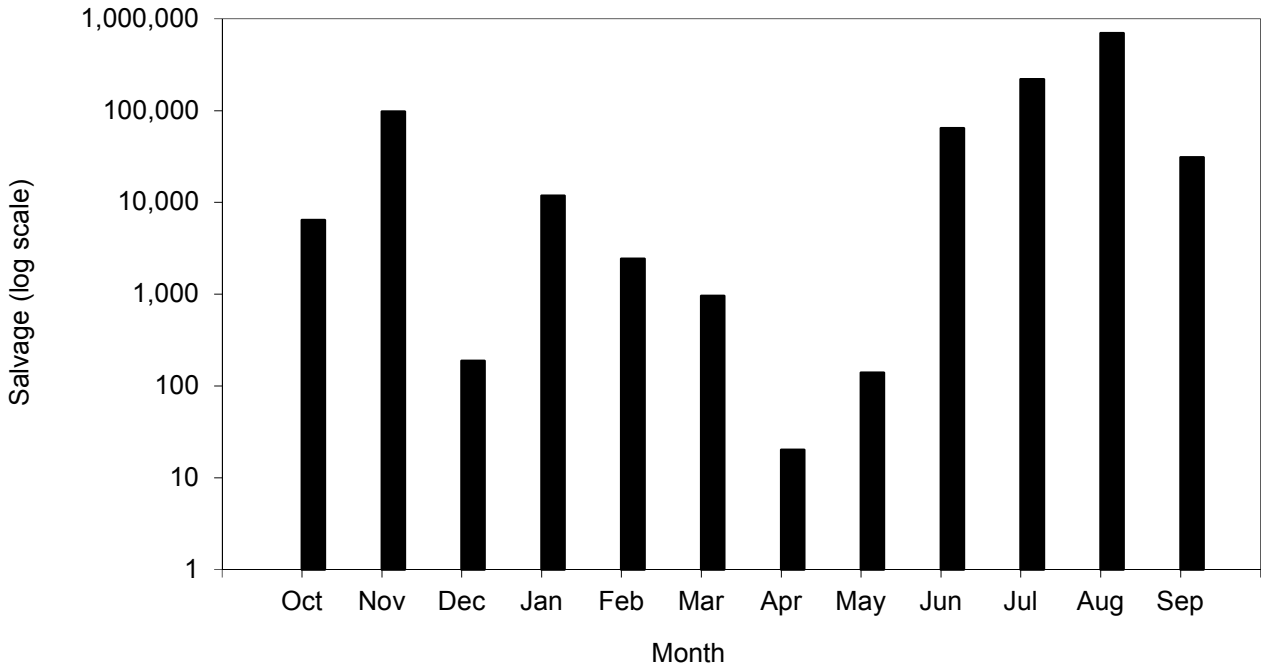

Figure 15 Monthly salvage of Threadfin Shad at the TFCF, WY 2016

References

California Dept. of Fish and Wildlife. 2014. Delta Model length at date table.

Available at: ftp://ftp.dfg.ca.gov/salvage/

Footnotes

1. Pelagic Organism Decline (POD) species

Appendix A Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2016 and 2015

Species	2016 Salvage	% Composition	2015 Salvage	% Composition
Threadfin Shad	1,127,956	78.5	114,804	38.8
Bluegill	131,079	9.1	107,883	36.5
Striped Bass	61,787	4.3	21,398	7.2
Largemouth Bass	47,736	3.3	11,278	3.8
White Catfish	15,165	1.1	7,979	2.7
Inland Silverside	11,223	0.8	4,187	1.4
Shimofuri Goby	8,443	0.6	11,467	3.9
Rainwater Killifish	6,869	0.5	2,240	0.8
Golden Shiner	4,985	0.3	1,232	0.4
American Shad	4,553	0.3	3,384	1.1
Pacific Lamprey	2,418	0.2	265	<0.1
Lamprey Unknown	2,356	0.2	31	<0.1
Prickly Sculpin	2,069	0.1	2,836	1.0
Channel Catfish	1,859	0.1	1,276	0.4
Western Mosquitofish	1,776	0.1	837	0.3
Redear Sunfish	1,381	0.1	949	0.3
Black Crappie	1,208	<0.1	808	0.3
Chinook Salmon	970	<0.1	187	<0.1
Red Shiner	886	<0.1	24	<0.1
Sacramento Sucker	661	<0.1	0	0.0
Steelhead	652	<0.1	124	<0.1
Yellowfin Goby	532	<0.1	1,545	0.5
Bigscale Logperch	277	<0.1	148	<0.1
Threespine Stickleback	217	<0.1	164	<0.1
Splittail	109	<0.1	12	<0.1
Warmouth	96	<0.1	48	<0.1
Black Bullhead	58	<0.1	324	0.1
Brown Bullhead	36	<0.1	172	<0.1
Green Sunfish	36	<0.1	32	<0.1
Striped Mullet	28	<0.1	88	<0.1
Spotted Bass	20	<0.1	0	0.0
River Lamprey	16	<0.1	4	<0.1
Shokihaze Goby	16	<0.1	0	0.0
Smallmouth Bass	16	<0.1	0	0.0

Appendix A (Cont.) Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2016 and 2015

Species	2016 Salvage	% Composition	2015 Salvage	% Composition
Delta Smelt	12	<0.1	68	<0.1
Common Carp	8	<0.1	0	0.0
Fathead Minnow	8	<0.1	0	0.0
Longfin Smelt	8	<0.1	28	<0.1
Sacramento Blackfish	8	<0.1	0	0.0
Starry Flounder	8	<0.1	12	<0.1
Pacific Staghorn Sculpin	4	<0.1	12	<0.1
Tule Perch	4	<0.1	4	<0.1
White Crappie	2	<0.1	4	<0.1