Fish Salvage at the Tracy Fish Collection Facility during the 2018 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 2018 water year (10/1/2017-9/30/2018) 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 (JPP) 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 2018 were noted. Salvage data from WYs 1981 to 2018 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 obtained by multiplying routine sample counts by an expansion factor calculated as salvage minutes divided by minutes of the sample count:

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

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 2018.

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 initially determined by the Delta criteria based on length at date of salvage (California Dept. of Fish and Wildlife 2014). If Coded Wire Tag (CWT) information was available, the race of hatchery Chinook Salmon was updated. Also, If DNA race information was available, the race of wild Chinook Salmon was updated.

Chinook Salmon loss estimates are presented because they are used to measure the fishery impact of the water export operation. Loss is the estimated number of fish encountered by the facility minus the number of fish that survived salvage operations (California Dept. of Fish and Wildlife 2013). Loss was subcategorized by origin and race.

Daily loss estimates are used as a regulatory trigger to protect listed salmonid species by reducing CVP and SWP water exports. The Biological Opinion (BO) established the use of daily loss densities to trigger mandatory consultation with the National Marine

Fisheries Service (NMFS) and water export reductions. In addition, Federal and State export agencies must monitor and report annual loss of listed salmonids to avoid exceeding the BO's Incidental Take Limits.

Larval fish sampling was conducted during March 29 through June 25 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 2,291,049 acre feet (AF) of water, which was a small decrease from WY 2017 (2,679,464 AF), but a large increase from WY 2016 (1,360,026 AF) and the record low in WY 2015 (695,650 AF; Figure 1). The annual export, as in WY 2017, was higher than exports from drought years WYs 2012-2016 which ranged from 695,650 to 2,076,833 AF. Increases in exports in WYs 2017-2018 coincided with increased rainfall following five years of drought conditions in California.

The highest monthly water exports occurred in October and December 2017 and July-September 2018 (Figure 2). During these periods, a total of 1,256,771 AF was exported, accounting for 54.86% of the total export. Monthly exports ranged from 102,019 AF in February to 268,240 AF in October.

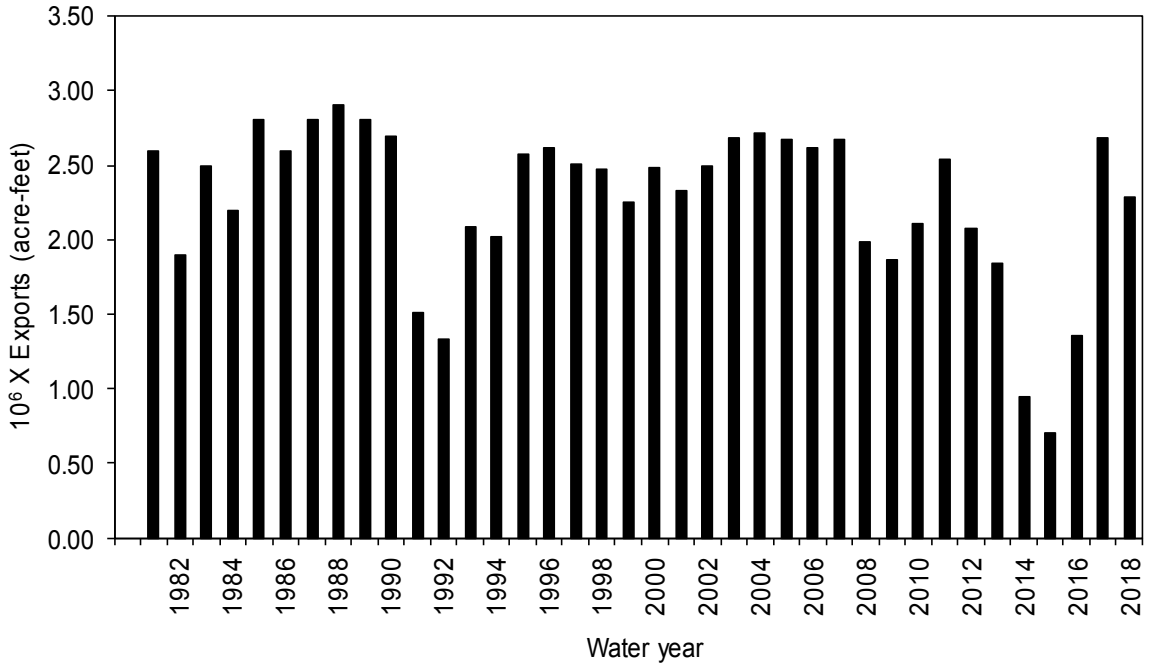

Figure 1 Annual exports (by water year; WY) in millions of acre-feet for the Central Valley Project, WYs 1981–2018

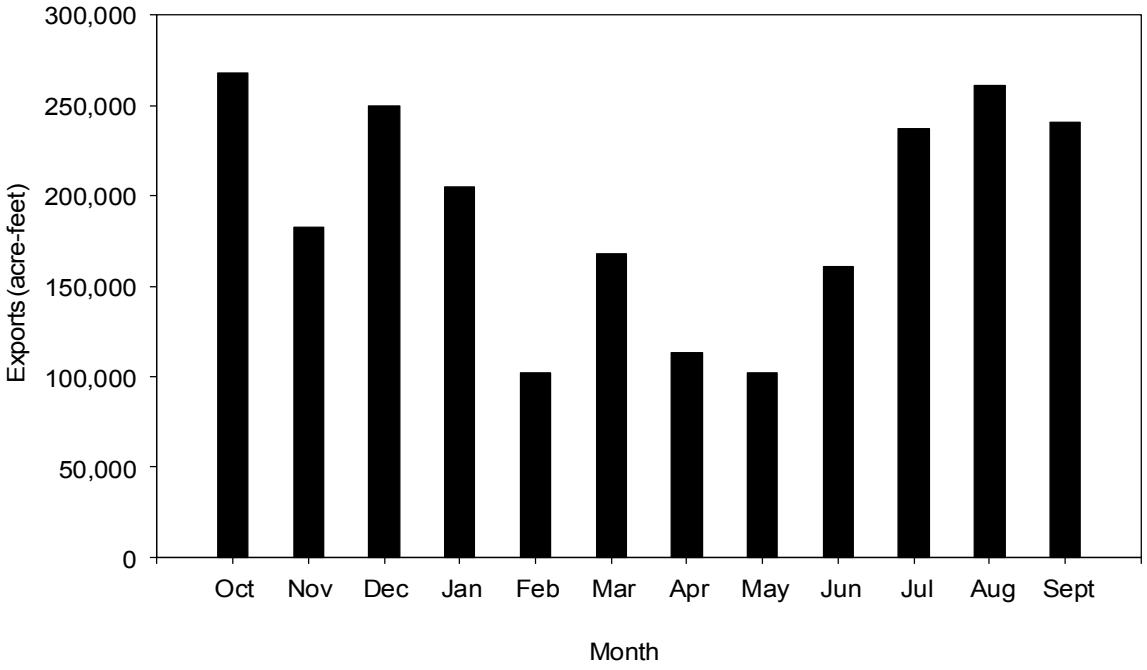

Figure 2 Monthly exports (in acre-feet) for the Central Valley Project, WY 2018

Total Salvage and Prevalent Species

Total fish salvage (all fish combined) at the TFCF was 1,432,489 (Figure 3). This total was a decrease from WY 2017 (2,061,133) and WY 2016 (1,437,551), but an increase from WY 2015 (295,854) and the record low salvage in WY 2014 (160,681). The WY 2018 total was well below the record high salvage of 37,659,835 in WY 2006.

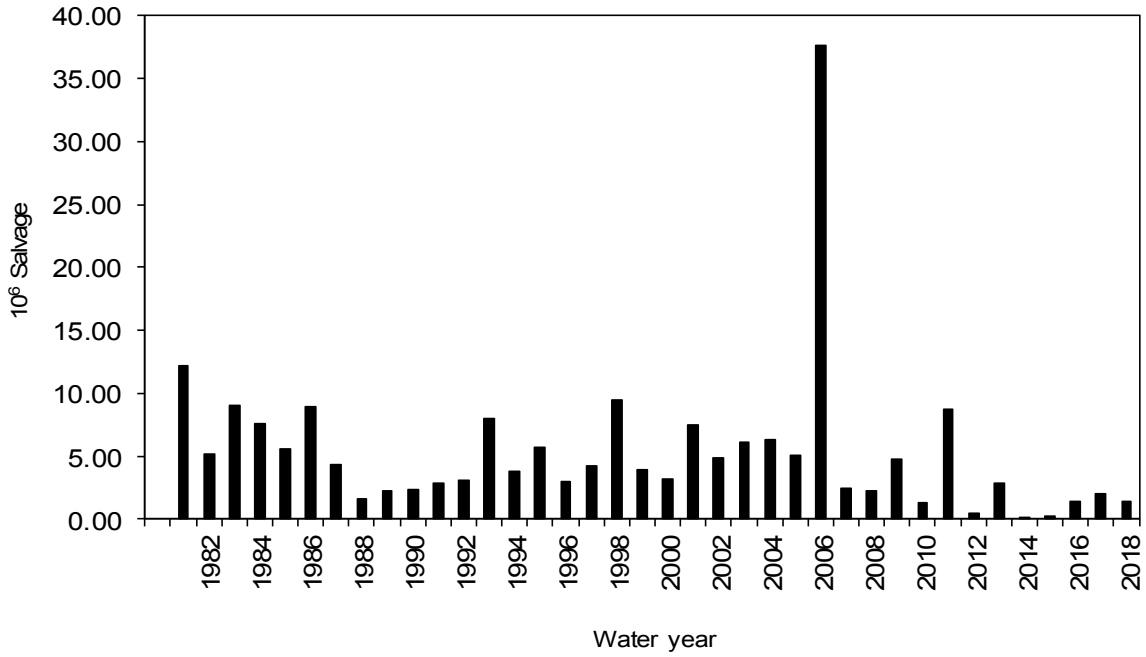

Figure 3 Annual salvage (by water year, WY; in millions) of all fish taxa combined at the TFCF, WYs 1981–2018

Threadfin Shad accounted for 74.6% 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 American Shad (6.2%), White Catfish (4.9%), Largemouth Bass (4.4%), and Striped Bass (3.1%). Native species comprised 2.9% of total fish salvage. This was a large decrease from WY 2017 when native species

comprised 22.1% of salvage and the increase in WY 2017 was largely due to an increase in Splittail salvage. Listed species including Chinook Salmon, Steelhead, and Delta Smelt accounted for 1.1% of salvage. This was equal to WY 2017 when these species also comprised 1.1% of salvage.

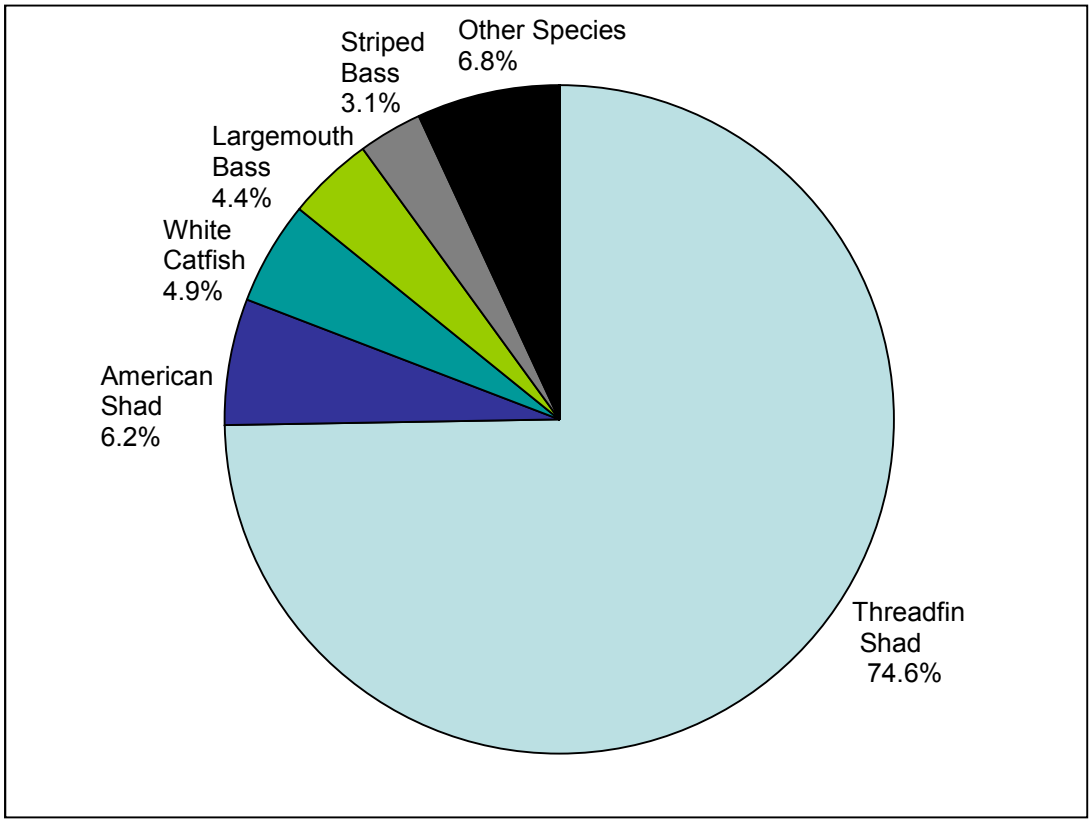

Figure 4 Percentages of annual salvage for the 5 most-prevalent species and other species combined at the TFCF, WY 2018

Chinook Salmon

The annual salvage of juvenile and large (>300 mm FL) Chinook Salmon was 14,315 for all races and origins combined (Figure 5; Appendix A). Salvage of Chinook Salmon in WY 2018 was a decrease from WY 2017 (23,633) but a large increase from WY 2016

(970) and the record low in WY 2015 (187). Mean salvage for WYs 2001-2018 was only 10.9% of the mean salvage for WYs 1981-2000.

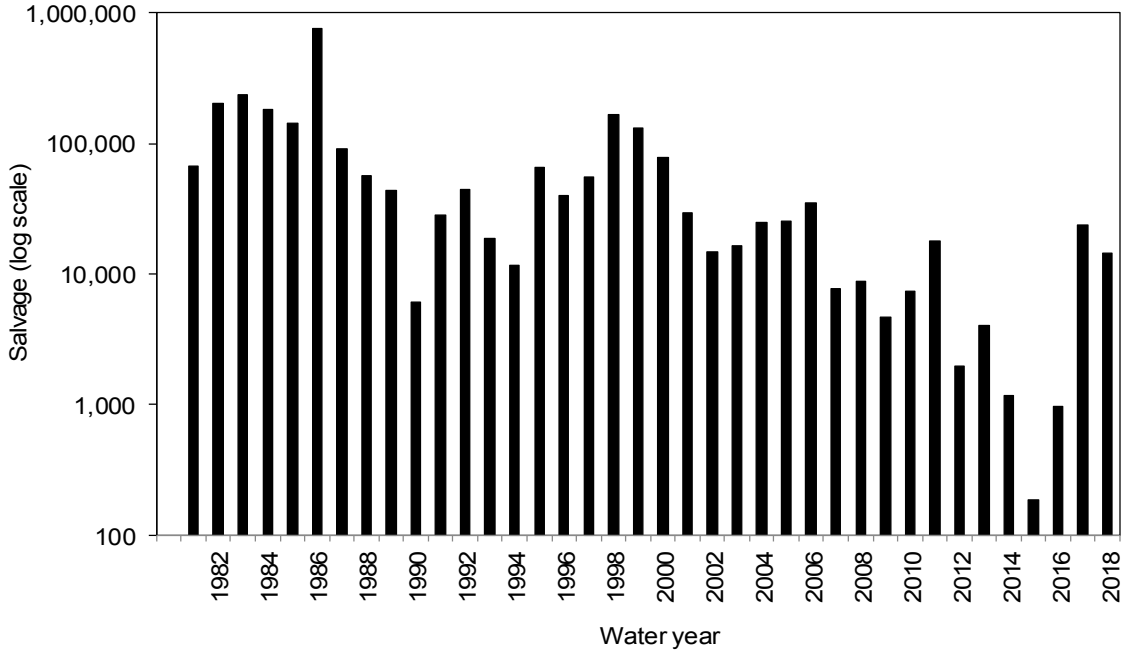

Figure 5 Annual salvage of Chinook Salmon (all races and origins combined) at the TFCF, WYs 1981–2018

Wild Chinook Salmon consisted primarily of fall run sized fish (54.1%) followed by spring run sized fish (45.5%, Table 1). Wild spring run fish were salvaged in March-May while fall run fish were salvaged in March-June (Figure 6). The most of wild spring run sized fish (55.5%) were salvaged in April. The largest proportion of wild fall run sized fish (54.9%) was salvaged in May. The estimated loss of Chinook Salmon was 10,153 (Table 1).

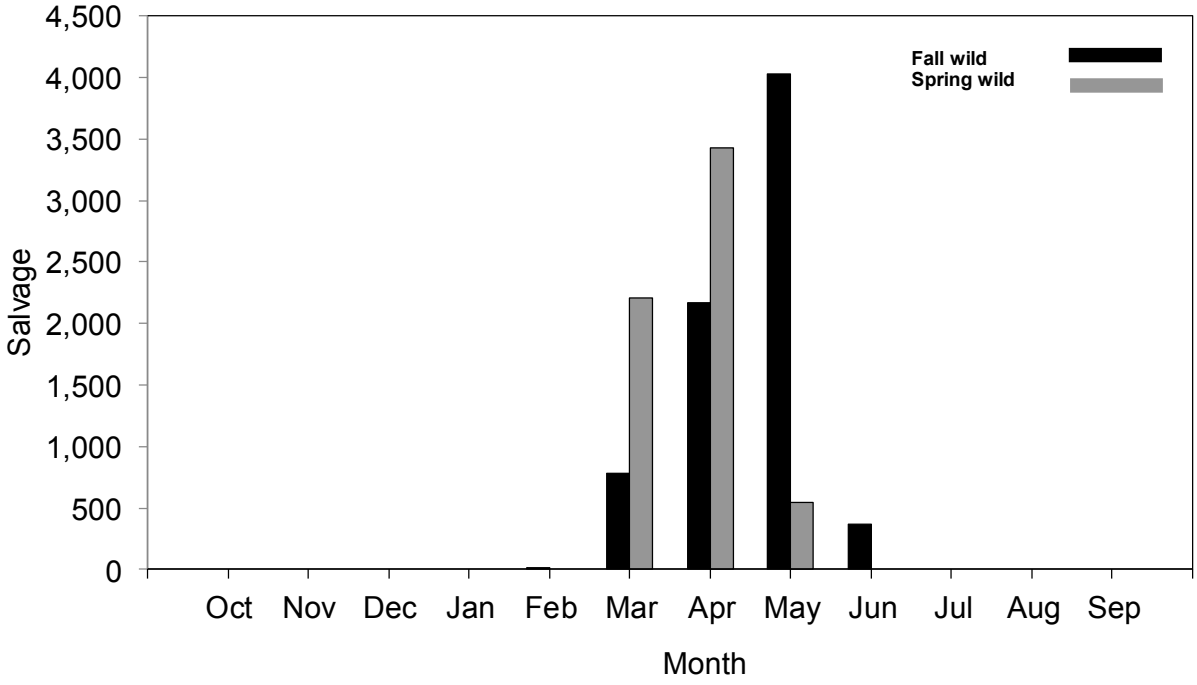

Figure 6 Monthly salvage of wild spring and fall run sized Chinook Salmon at the TFCF, WY 2018

Table 1 Chinook Salmon annual salvage, percentages of annual salvage, and losses at the TFCF, WY 2018, by race and origin (wild or hatchery)

Origin	Race	Salvage	Percentage	Loss
Wild	Fall	7,341	54.1	5,363
	Late-fall	4	<0.1	3
	Spring	6,176	45.5	4,258
	Winter	56	0.4	42
Total Wild		**13,577**		**9,666**
Hatchery	Fall	0	0.0	0
	Late-fall	21	2.9	17
	Spring	708	95.9	465
	Winter	8	1.1	5
	Unknown race	1	0.1	*
Total Hatchery		**738**		**487**
Grand Total		***14,315***		***10,153***

*Loss is not calculated for Unknown race Chinook Salmon

Steelhead

Salvage of wild and hatchery Steelhead (740) was a large increase from the record low in WY 2017 (30) and a small increase from WY 2016 (652) which continued the pattern of mostly low salvage observed since WY 2005 (Figure 7).

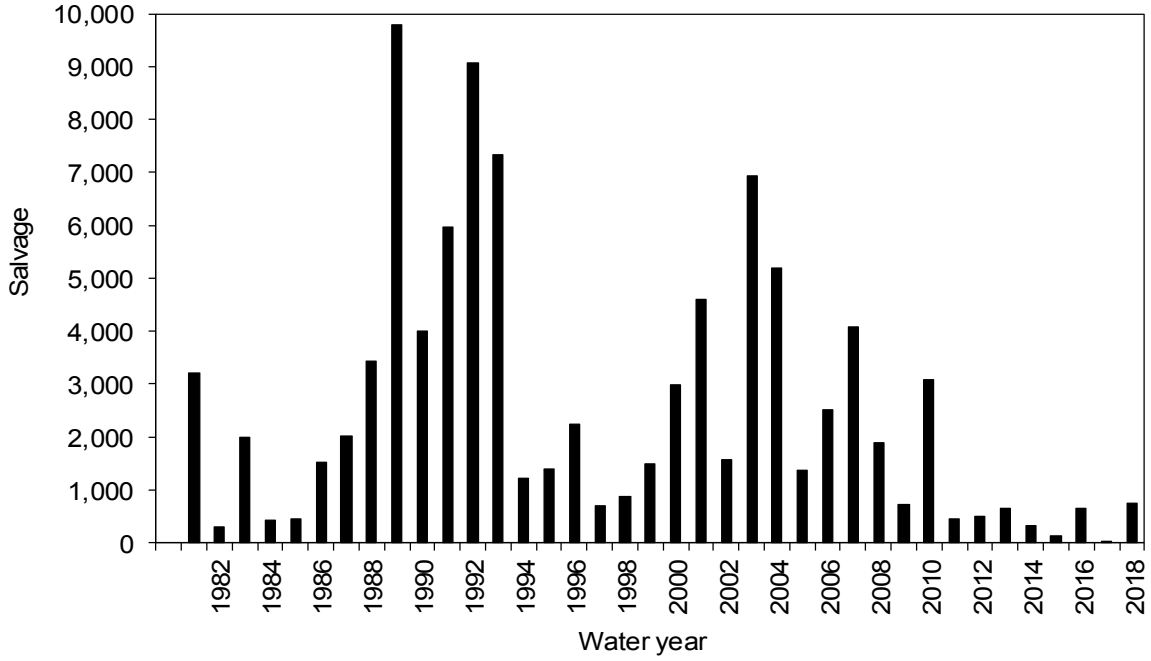

Figure 7 Annual salvage of Steelhead (all origins combined) at the TFCF, WYs 1981–2018

Juvenile Steelhead salvage estimates were primarily of wild origin. The salvage composition was 546 wild and 194 hatchery fish.

Wild Steelhead were salvaged in February-June while hatchery Steelhead were salvaged in January-April (Figure 8). Hatchery and wild Steelhead were most frequently salvaged in March.

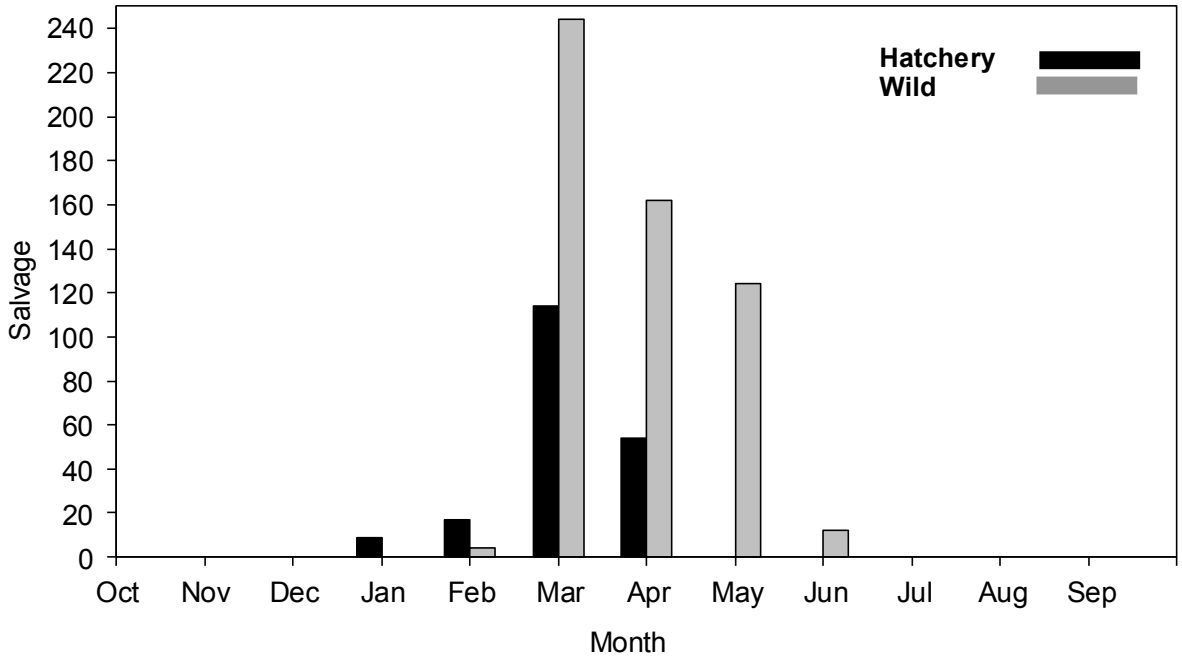

Figure 8 Monthly salvage of hatchery and wild Steelhead at the TFCF, WY 2018

Striped Bass

The annual salvage of 44,481 Striped Bass continued the low salvage trend observed since WY 1995 (Figure 9). Prior to WY 1995, annual Striped Bass salvages were above 1,000,000, except for WYs 1983 and 1988.

Most Striped Bass were salvaged in June-July (Figure 10). The June salvage (22,675) and July salvage (9,646) accounted for 72.7% of the total salvage. Striped Bass were salvaged every month and the lowest salvage occurred in February (64).

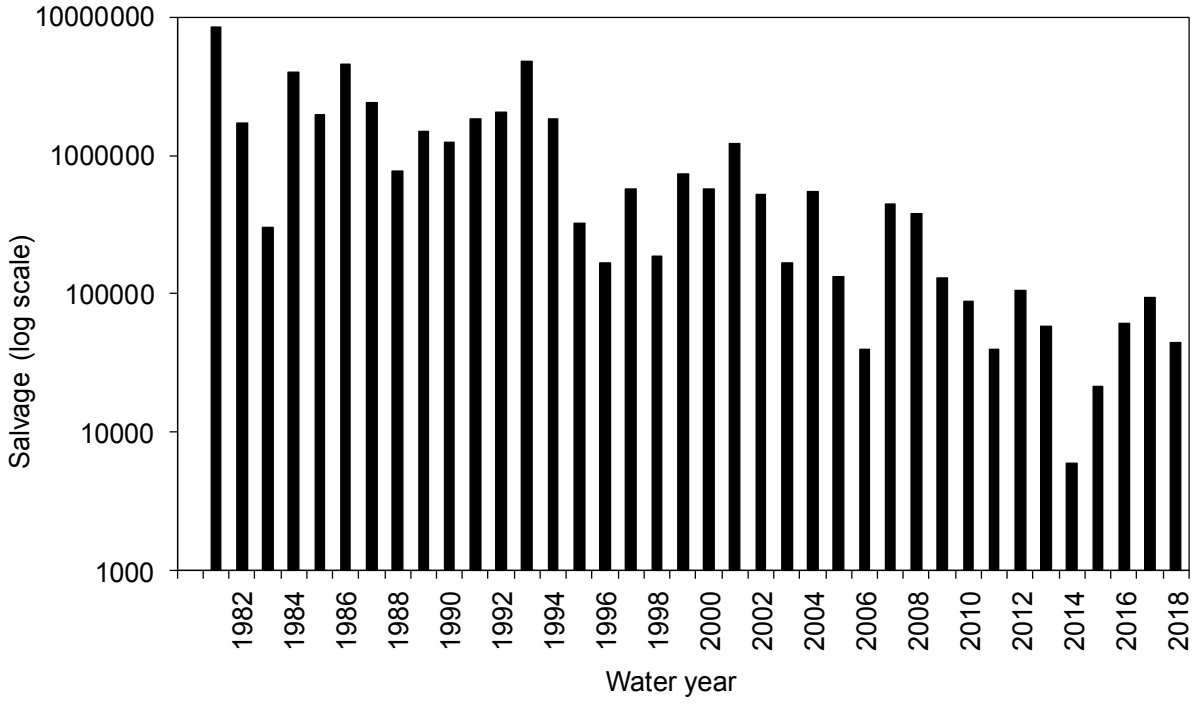

Figure 9 Annual salvage of Striped Bass at the TFCF, WYs 1981–2018

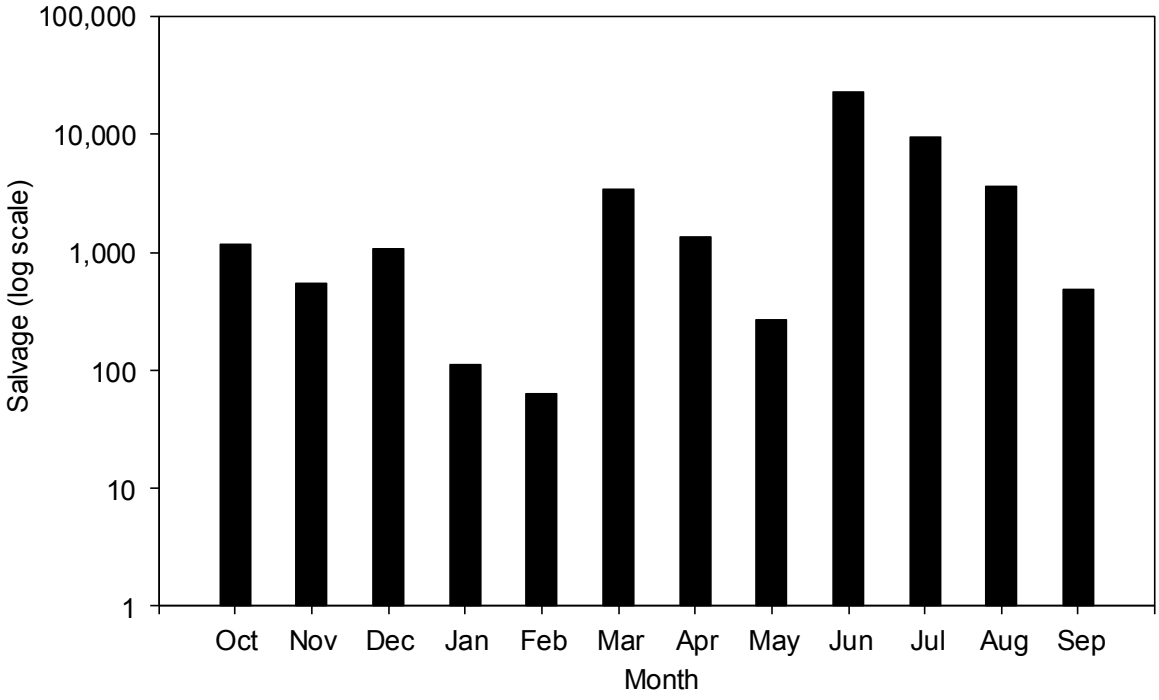

Figure 10 Monthly salvage of Striped Bass at the TFCF, WY 2018

Delta Smelt

Salvage of Delta Smelt was a record low (4) and a marked decrease from WY 2017 (32) and WY 2016 (12, Figure 11). 2005-2018 was the lowest 14-year period of annual salvage on record (4-1,009).

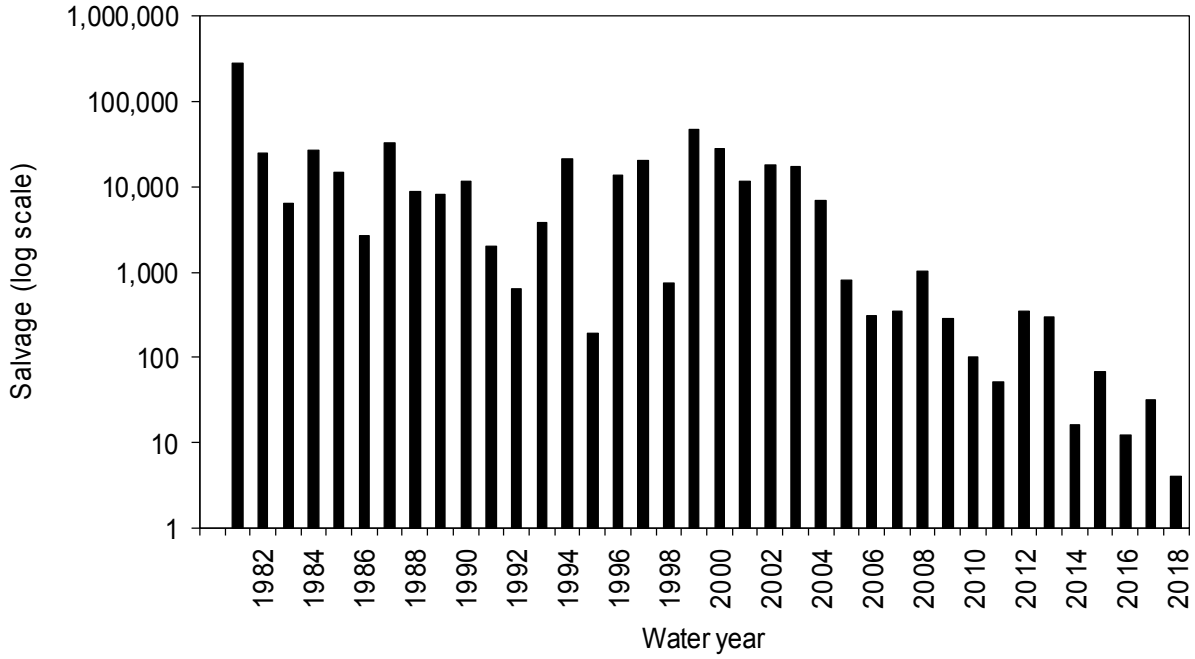

Figure 11 Annual salvage of Delta Smelt at the TFCF, WYs 1981–2018

Adult Delta Smelt were only salvaged in March. No juvenile Delta Smelt was salvaged in WY 2018. No Delta Smelt less than 20 mm FL was detected in WY 2018, as in WYs 2016-2017.

Longfin Smelt

No Longfin Smelt was salvaged at the TFCF in WY 2018 (Figure 12). This was equal to WY 2017 and a marked decrease from WY 2016 (8). No salvage of Longfin Smelt also

occurred in WY 2017, WY 2006, WY 1995, and WY 1982. Low annual salvages have generally been observed since 1995, with the exception of 43,056 salvaged in WY 2002, and generally coincides with the declining annual populations of Longfin Smelt. Mean salvage for WYs 1995-2018 was only 34.9% of the mean salvage for WYs 1981-1994. Years of no salvage generally occurred in wet years where the author hypothesizes that high outflows pushed the population downstream of the influence of the export pumps. No Longfin Smelt less than 20 mm FL was detected in WY 2018, which was equal to WY 2017 and a small decrease from WY 2016 (1).

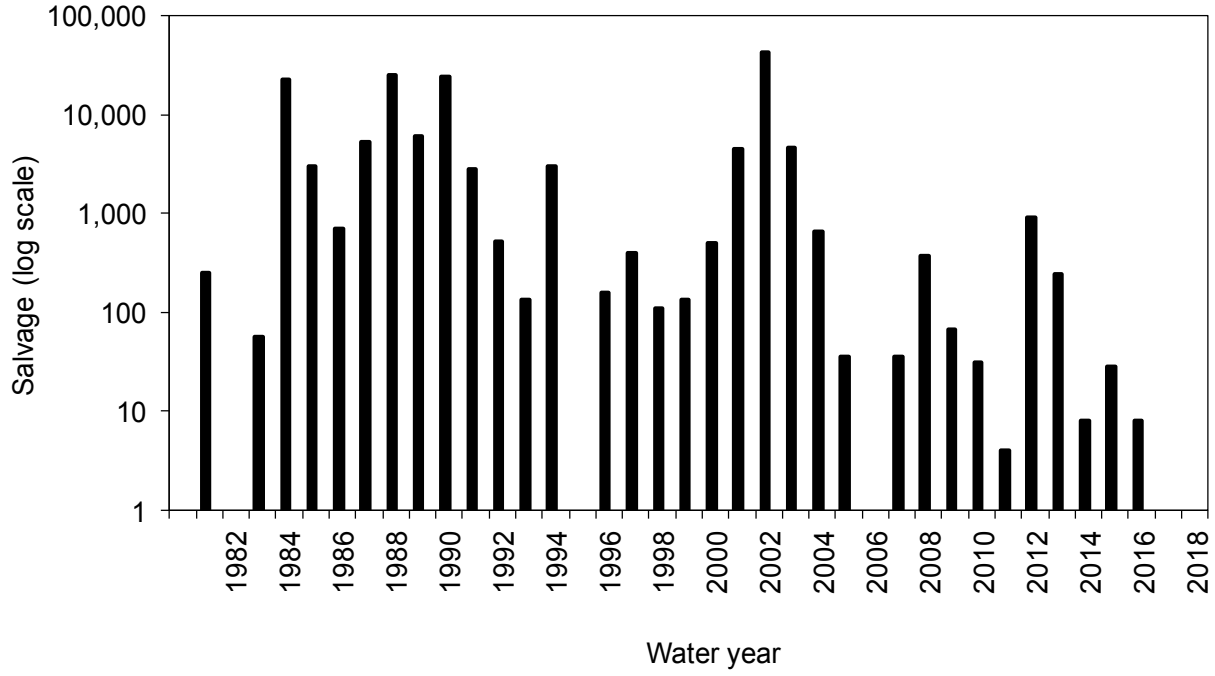

Figure 12 Annual salvage of Longfin Smelt at the TFCF, WYs 1981–2018

Splittail

The salvage of juvenile and adult Splittail (7,788) was a marked decrease from WY 2017 (415,517) and the record high in WY 2011 (7,660,024), but a marked increase from WY 2016 (109) and the record lows in WY 2015 (12) and WY 2014 (12). 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.

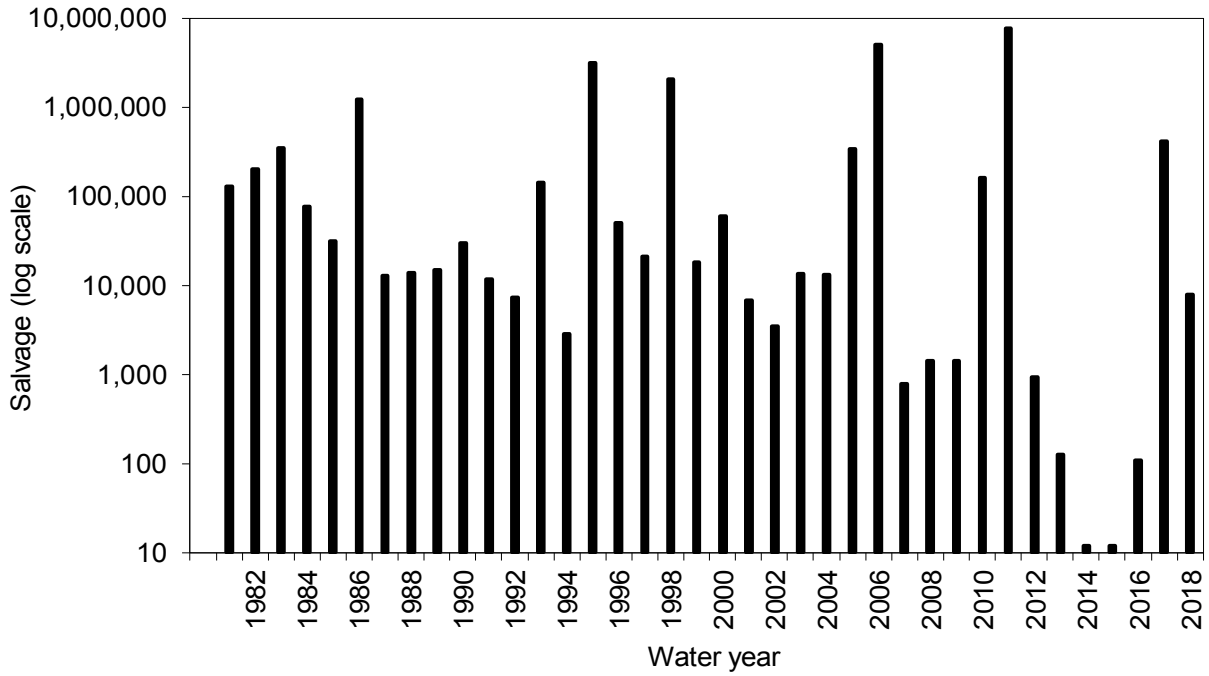

Figure 13 Annual salvage of Splittail at the TFCF, WYs 1981–2018

Threadfin Shad

The salvage of juvenile and adult Threadfin Shad (1,068,584) was an increase from WY 2017 (731,760) but a decrease from WY 2016 (1,127,956). WY 2018 salvage was

markedly higher from WY 2015 (114,804) and WY 2014 (47,603). 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 (3.5-5.2 million).

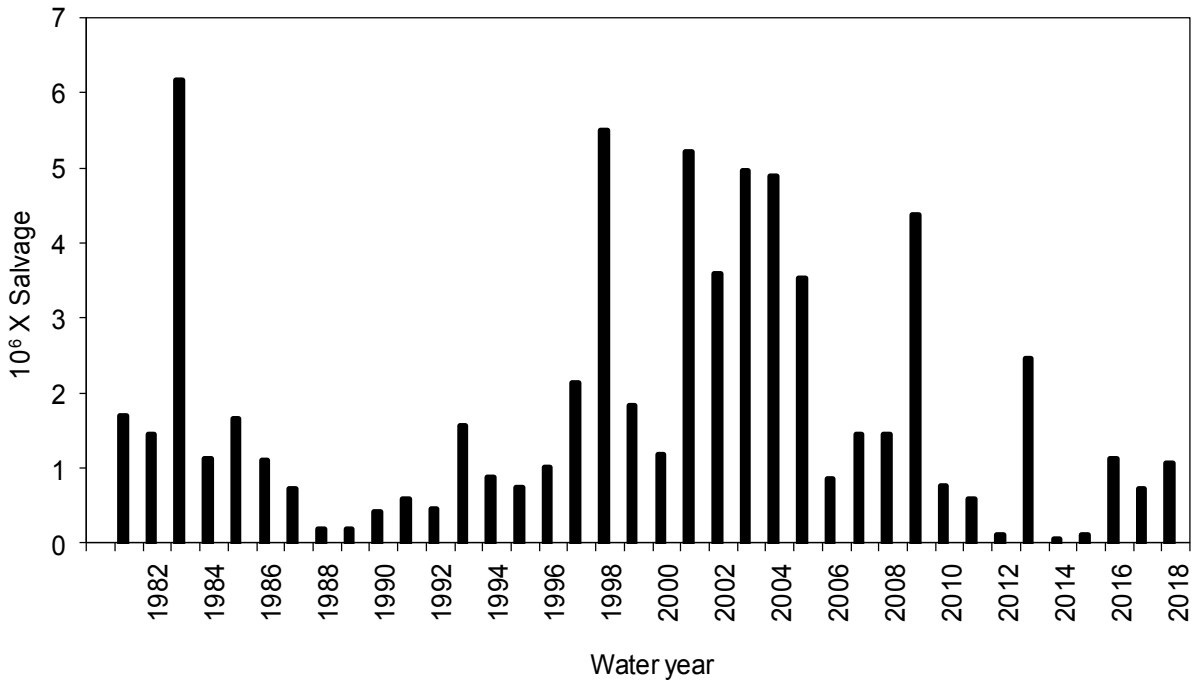

Figure 14 Annual salvage (in millions) of Threadfin Shad at the TFCF, WYs 1981–2018

The monthly salvage of Threadfin Shad in WY 2018 followed the same seasonal trend as observed in past years. The highest salvage of Threadfin Shad occurred in July-August (880,060) and accounted for 82.4% of the WY 2018 salvage (Figure 15). Threadfin shad were salvaged every month and the lowest salvage occurred in May (620). Adult Threadfin Shad were mostly salvaged in fall and winter. Juvenile Threadfin Shad were mostly salvaged in summer and fall.

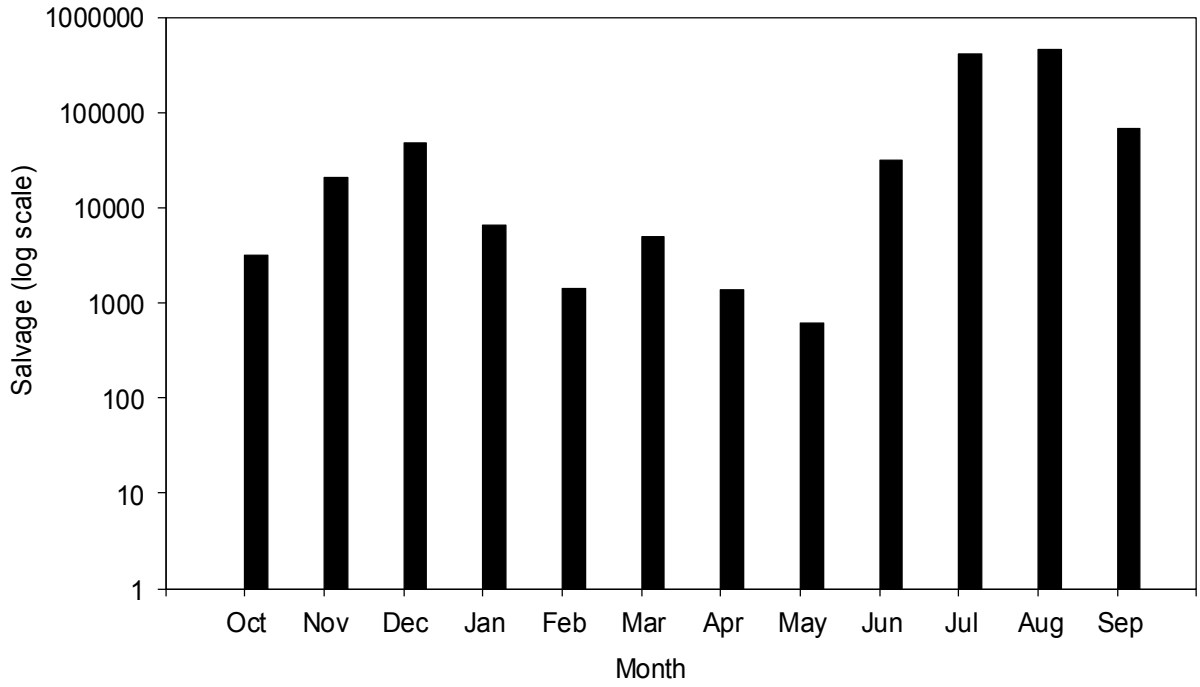

Figure 15 Monthly salvage of Threadfin Shad at the TFCF, WY 2018

References

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

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

California Dept. of Fish and Wildlife. 2013. Salmon loss estimation.

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 2018 and 2017

Species	2018 Salvage	% Composition	2017 Salvage	% Composition
Threadfin Shad	1,068,584	74.6	731,760	35.5
American Shad	88,497	6.2	405,336	19.7
White Catfish	69,832	4.9	107,330	5.2
Largemouth Bass	62,493	4.4	47,643	2.3
Striped Bass	44,481	3.1	94,467	4.6
Bluegill	22,813	1.6	123,970	6.0
Prickly Sculpin	16,981	1.2	1,189	<0.1
Chinook Salmon	14,315	1.0	23,633	1.1
Channel Catfish	11,858	0.8	21,350	1.0
Splittail	7,788	0.5	415,517	20.2
Inland Silverside	7,287	0.5	11,181	0.5
Shimofuri Goby	6,928	0.5	17,114	0.8
Yellowfin Goby	4,139	0.3	2,468	0.1
Rainwater Killifish	1,516	0.1	4,151	0.2
Lamprey Unknown	968	<0.1	13,559	0.7
Steelhead	740	<0.1	30	<0.1
Golden Shiner	707	<0.1	7,013	0.3
Black Crappie	677	<0.1	2,981	0.1
Redear Sunfish	509	<0.1	3,496	0.2
Western Mosquitofish	296	<0.1	1,711	<0.1
Pacific Lamprey	204	<0.1	164	<0.1
Bigscale Logperch	169	<0.1	162	<0.1
Common Carp	158	<0.1	21,952	1.1
Threespine Stickleback	113	<0.1	475	<0.1
Brown Bullhead	96	<0.1	88	<0.1
Starry Flounder	76	<0.1	24	<0.1
Black Bullhead	55	<0.1	452	<0.1
Sacramento Sucker	52	<0.1	836	<0.1
Warmouth	36	<0.1	113	<0.1
Pacific Staghorn Sculpin	28	<0.1	0	0.0
Goldfish	12	<0.1	596	<0.1
Green Sunfish	12	<0.1	32	<0.1

Appendix A (Cont.) Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2018 and 2017

Species	2018 Salvage	% Composition	2017 Salvage	% Composition
Red Shiner	12	<0.1	76	<0.1
Sacramento Pikeminnow	12	<0.1	40	<0.1
White Sturgeon	12	<0.1	68	<0.1
Blue Catfish	9	<0.1	0	0.0
Delta Smelt	4	<0.1	32	<0.1
Sacramento Blackfish	4	<0.1	16	<0.1
Shokihaze Goby	4	<0.1	28	<0.1
Tule Perch	4	<0.1	12	<0.1
Wakasagi	4	<0.1	4	<0.1
White Crappie	4	<0.1	20	<0.1
Fathead Minnow	0	0.0	12	<0.1
Large-Scale Loach	0	0.0	12	<0.1
Spotted bass	0	0.0	8	<0.1
Hitch	0	0.0	4	<0.1
Green Sturgeon	0	0.0	4	<0.1
River Lamprey	0	0.0	4	<0.1