

Fish Salvage at the Tracy Fish Collection Facility during the 2019 Water Year

by

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Introduction

The Tracy Fish Collection Facility (TFCF) diverts (salvages) fish from water exported from the southern portion of the Sacramento-San Joaquin Delta. After fish have been salvaged at the TFCF, the C.W. “Bill” Jones Pumping Plant (JPP) pumps water into the Delta Mendota Canal. Both the TFCF and JPP are integral parts of the Central Valley Project (CVP) which provides water for agriculture on the western side of the San Joaquin Valley. The fish are loaded into tanker trucks and trucked to release sites away from the immediate influence of the export pumps to be released into the western Delta. This report summarizes the 2019 water year (10/1/2018-9/30/2019) operational and biological information gathered from the TFCF. The following species are given individual consideration: Chinook Salmon (*Oncorhynchus tshawytscha*), Steelhead (*O. mykiss*), Striped Bass¹ (*Morone saxatilis*), Delta Smelt¹ (*Hypomesus transpacificus*), Longfin Smelt¹ (*Spirinchus thaleichthys*), Splittail (*Pogonichthys macrolepidotus*), and Threadfin Shad¹ (*Dorosoma petenense*).

Methods

Daily volumes of water exported were reported from gauge readings at the JPP in Byron. Monthly water exports were plotted and examined for time trends. Water year (WY) exports for the CVP from 1981 through 2019 were noted. Salvage data from WYs 1981 to 2019 were examined for long and short-term trends.

Diverted fish are subsampled and enumerated at the TFCF. The subsamples are expanded and reported as “estimated salvage” to quantify the fish abundance at the

facility. It should be noted that some fish species including Delta Smelt have a low survival rate through the salvage process. 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:

$$\text{SALVAGE}_{\text{SAMPLE}} = \text{COUNT}_{\text{SAMPLE}} \times (\text{SALVAGE MINUTES} / \text{MINUTES}_{\text{SAMPLE}}). \quad (1)$$

Predator removals were not expanded since they are removed with no salvage minutes:

$$\text{SALVAGE}_{\text{PREDATOR REMOVAL/SECONDARY FLUSH}} = \text{COUNT}_{\text{PREDATOR REMOVAL/SECONDARY FLUSH}}. \quad (2)$$

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 2019.

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. 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.

Larval fish sampling was conducted during March 18 through June 30 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 at 0400, 1000, 1600, and 2200 hours counts. Larval fish were identified to species by TFCF personnel and reported the next working day.

During May 10 to June 3, there were questions regarding the integrity of the salmon salvage and counts for one operator. Consequently, the decision was made by the United States Bureau of Reclamation (USBR) to remove some salvage and operational data from the database during this time period, no doubt resulting in underestimating salvage for some species.

Water Exports

The CVP exported 2,361,826 acre feet (AF) of water, which was a small increase from WY 2018 (2,291,049 AF), 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 2018, 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 2017-2019 coincided with increased rainfall following five years of drought conditions in California. The highest monthly water exports occurred in October and December 2018 and July-September 2019 (Figure 2). During these periods, a total of 1,241,323 AF was exported, accounting for 52.6% of the total export. Monthly exports ranged from 83,856 AF in May to 255,895 AF in July.

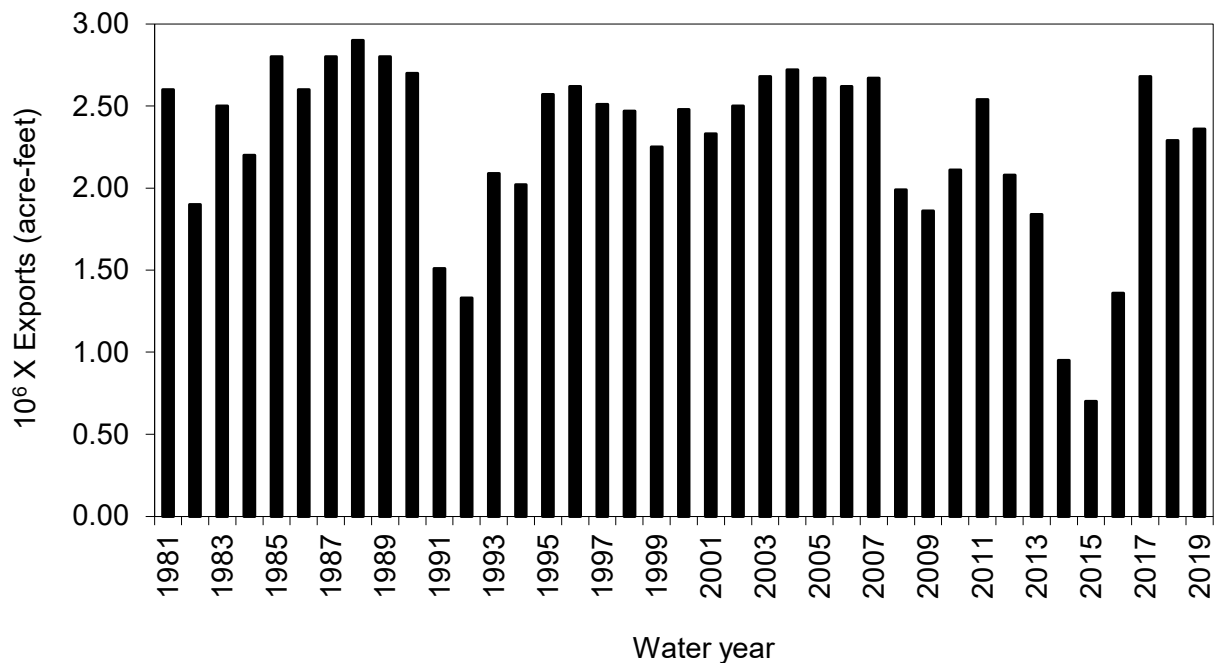


Figure 1. Annual exports (by water year; WY) in millions of acre-feet for the Central Valley Project, WYs 1981–2019

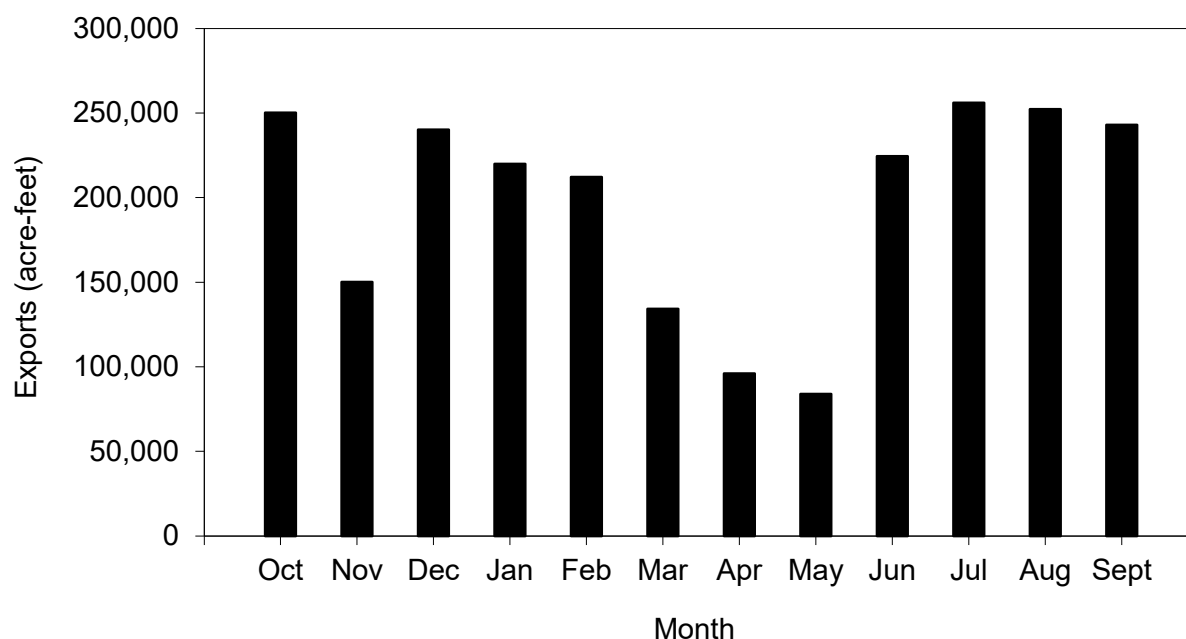


Figure 2. Monthly exports (in acre-feet) for the Central Valley Project, WY 2019

Total Salvage and Prevalent Species

Total fish salvage (all fish combined) at the TFCF was 1,463,817 (Figure 3). This total was a small increase from WY 2018 (1,432,489) but a decrease from WY 2017 (2,061,133). WY 2019 salvage was a substantial increase from the record low salvage in WY 2014 (160,681). The WY 2019 total was well below the record high salvage of 37,659,835 in WY 2006, most of which were Common Carp.

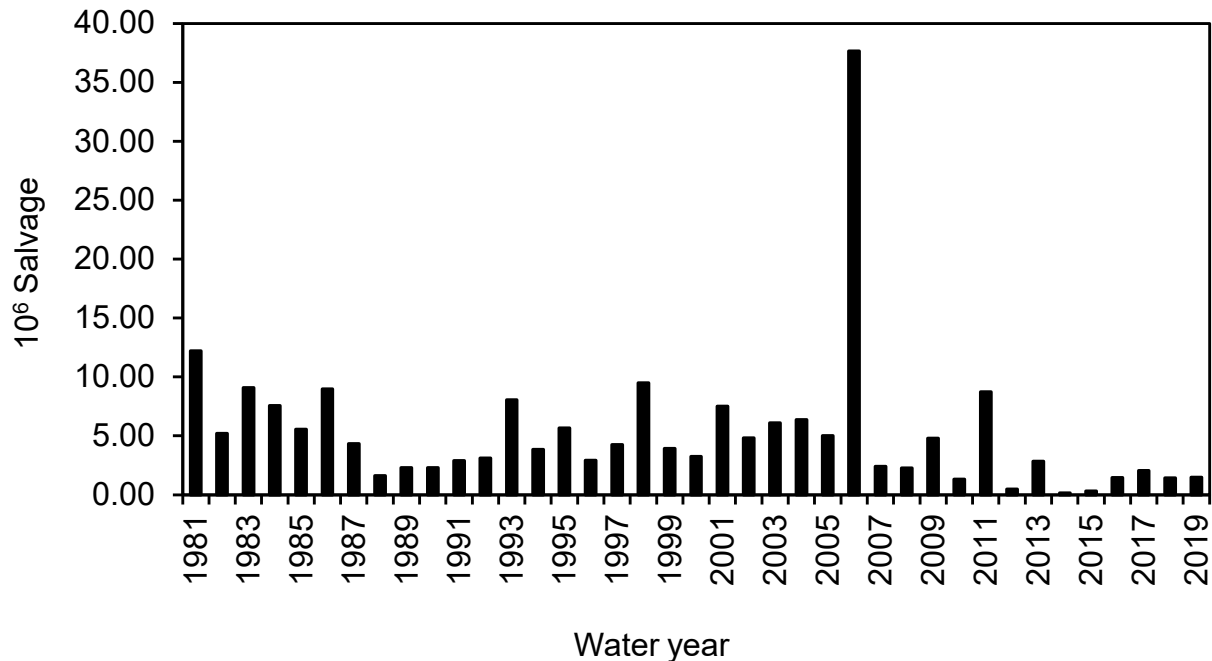


Figure 3. Annual salvage (by water year, WY; in millions) of all fish taxa combined at the TFCF, WYs 1981–2019

Threadfin Shad accounted for 50.5% 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 American Shad (14.3%), Bluegill (12.7%), White Catfish (4.7%), and Splittail (4.6%). Native species comprised 6.1% of total fish salvage. This was an increase from WY 2018 when native species comprised 2.9% of salvage. Listed species including Chinook Salmon, Steelhead, Longfin Smelt, and Delta Smelt accounted for 0.7% of salvage. This was a decrease from WY 2018 when these species comprised 1.1% of salvage.

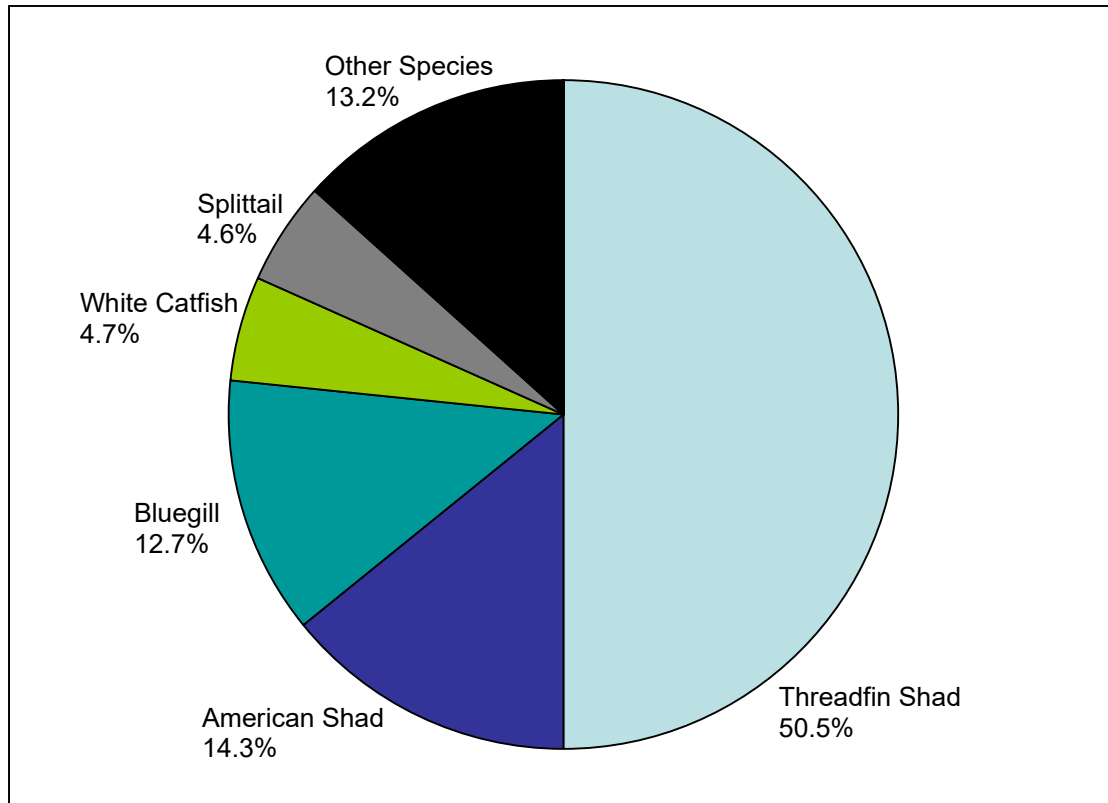


Figure 4. Percentages of annual salvage for the 5 most-prevalent species and other species combined at the TFCF, WY 2019

Chinook Salmon

The annual salvage of juvenile (>300 mm FL) Chinook Salmon was 9,083 for all races and origins combined (Figure 5; Appendix A). Salvage of Chinook Salmon in WY 2019 was a decrease from WY 2018 (14,315) and WY 2017 (23,633), but a large increase from WY 2016 (970) and the record low in WY 2015 (187). Mean salvage for WYs 2001-2019 was only 10.7% of the mean salvage for WYs 1981-2000.

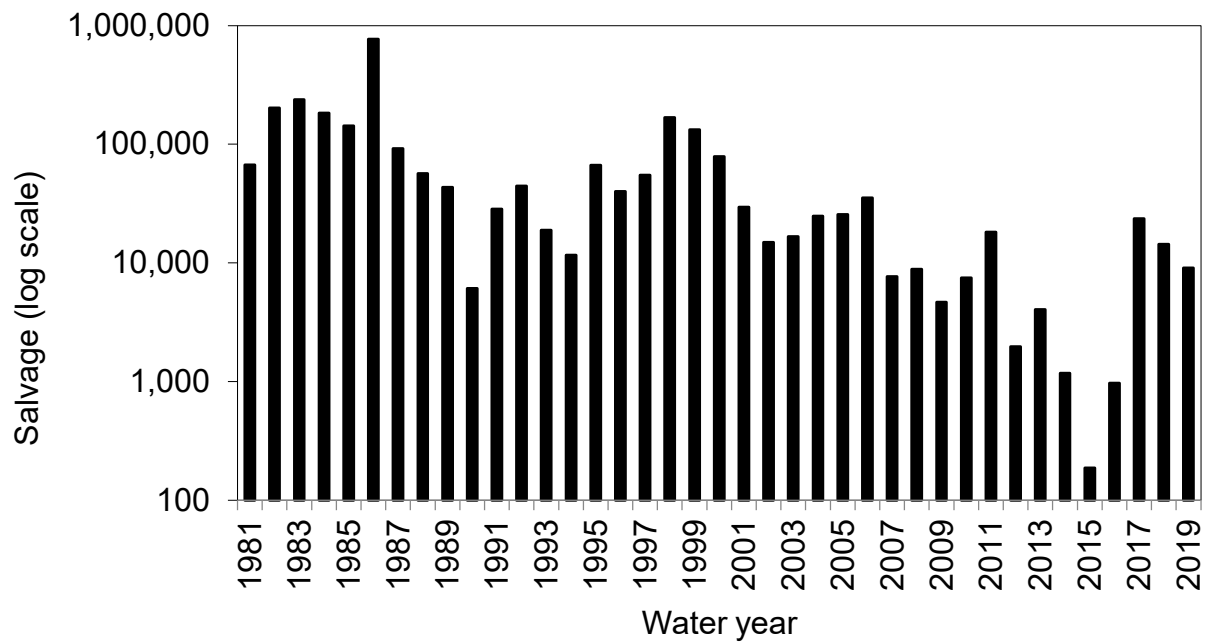


Figure 5. Annual salvage of Chinook Salmon (all races and origins combined) at the TFCF, WYs 1981–2019

Wild Chinook Salmon consisted primarily of fall run sized fish (88.2%) followed by spring run sized fish (11.1%; Table 1). However, DNA analysis of wild Chinook Salmon revealed that the vast majority of wild spring run sized salmon were in fact fall run salmon. Wild fall run fish were salvaged in December–July (Figure 6). The largest proportion of wild fall run sized fish (46.6%) was salvaged in May. The estimated loss of wild Chinook Salmon was 5,813 (Table 1), although the removal of some 0200–0800 count data during May 10 through June 3 resulted in Chinook Salmon being removed from the salvage and loss estimates resulting in underestimating salvage and loss, mostly for wild fall run fish.

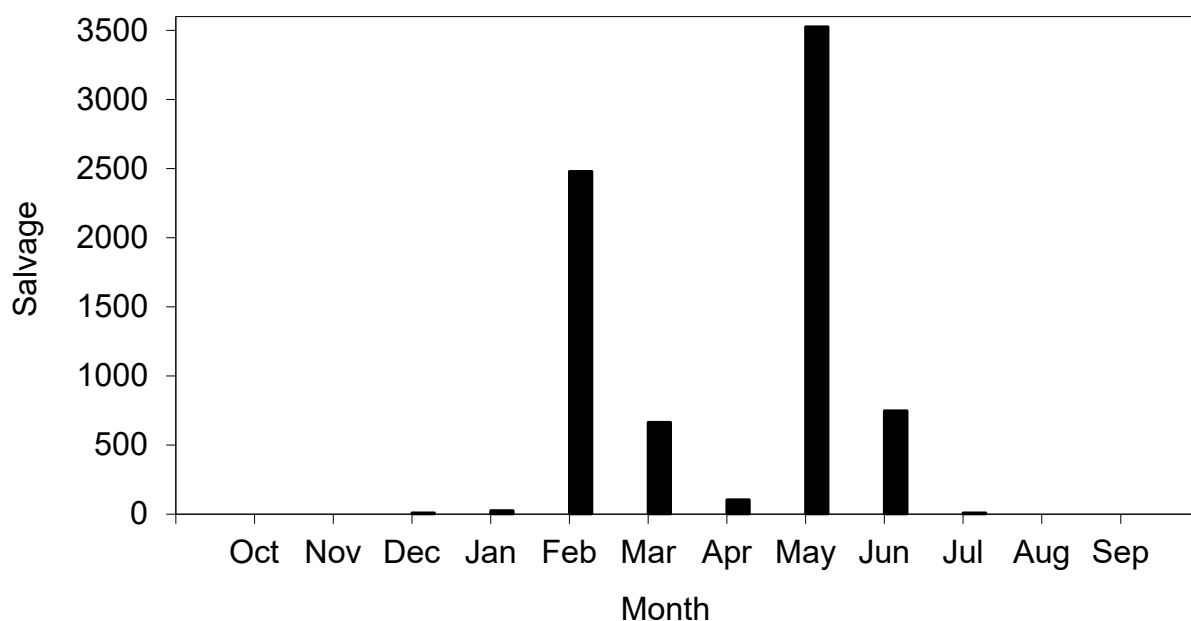


Figure 6. Monthly salvage of wild fall run sized Chinook Salmon at the TFCF, WY 2019. May/June are underestimated due to integrity the salvage and counts for one operator.

Table 1. Chinook Salmon annual salvage, percentages of annual salvage, and losses at the TFCF, WY 2019, by race and origin (wild or hatchery)

<u>Origin</u>	<u>Race</u>	<u>Salvage</u>	<u>Percentage</u>	<u>Loss</u>
Wild	Fall	7,560	88.2	5,011
	Late-fall	0	0.0	0
	Spring	952	11.1	758
	Winter	64	0.7	44
	Total Wild	8,576		5,813
Hatchery	Fall	4	0.8	3
	Late-fall	208	41.0	139
	Spring	291	57.4	222
	Winter	4	0.8	3
	Total Hatchery	507		367
Grand Total		9,083		6,180

Steelhead

Salvage of wild and hatchery Steelhead (725) was a small increase from WY 2018 (740), and a large increase from the record low in WY 2017 (30), which continued the pattern of mostly low salvage observed since WY 2005 (Figure 7).

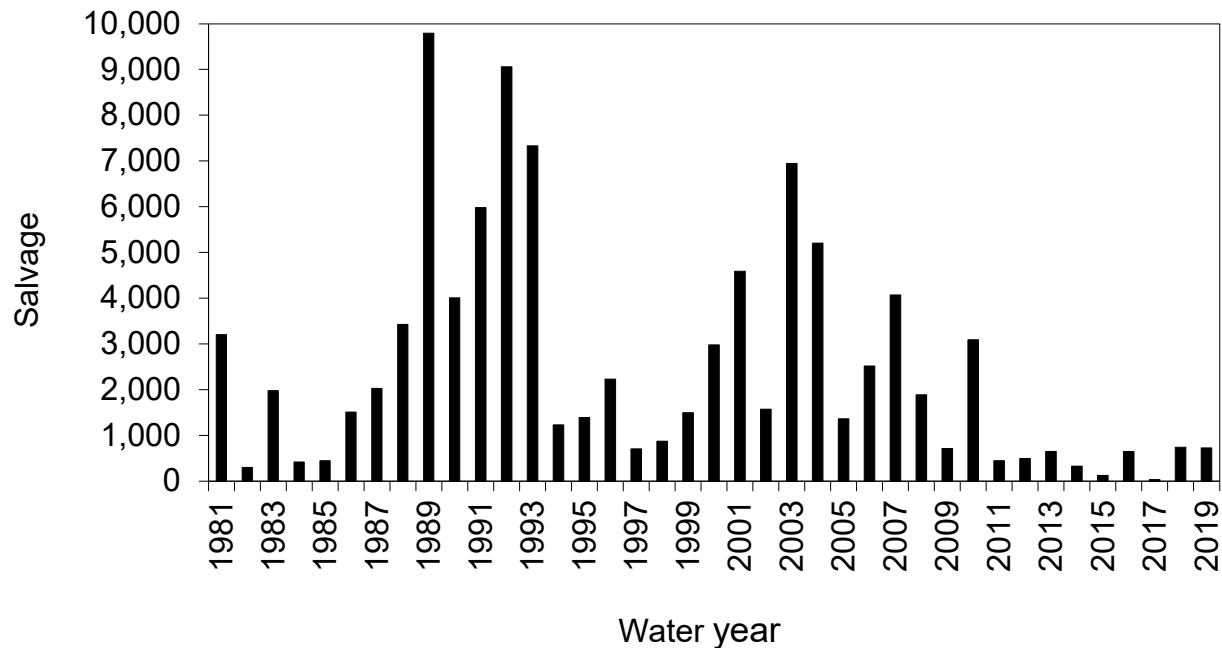


Figure 7. Annual salvage of Steelhead (all origins combined) at the TFCF, WYs 1981–2019

Juvenile Steelhead salvage estimates were primarily of hatchery origin, which was a shift from WY's 2018-2017 when wild steelhead were most salvaged. The salvage composition was 119 wild and 606 hatchery fish.

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

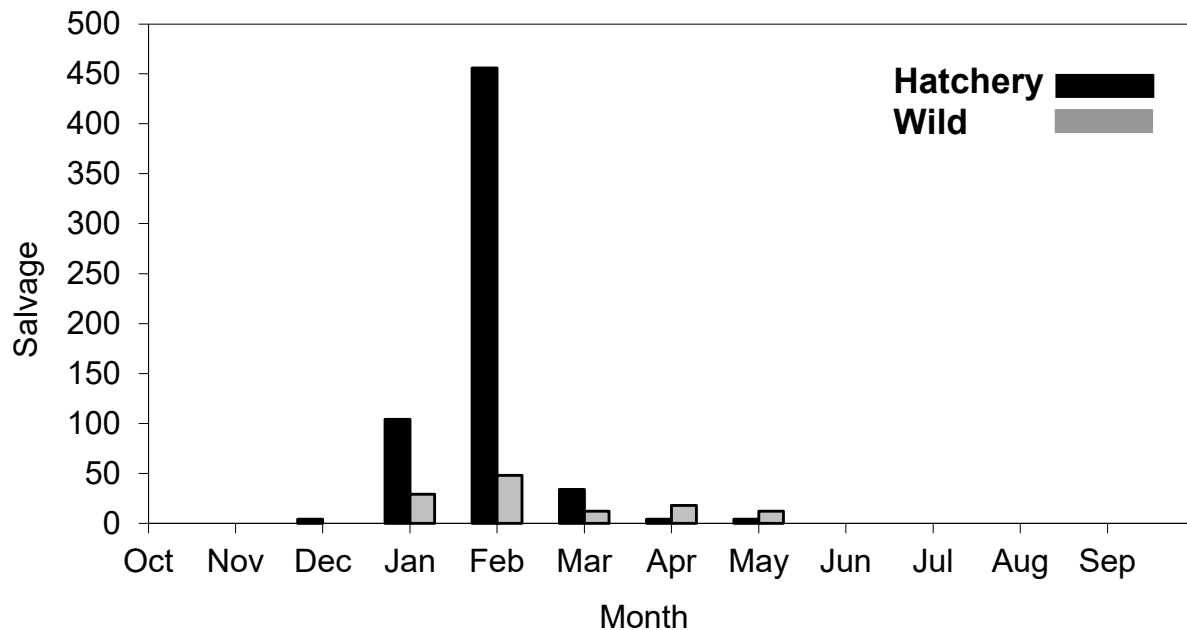


Figure 8. Monthly salvage of hatchery and wild Steelhead at the TFCF, WY 2019

Striped Bass

The annual salvage of Striped Bass (44,584) 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 (10,240) and July salvage (20,471) accounted for 68.9% of the total salvage. Striped Bass were salvaged every month and the lowest salvage occurred in April (12).

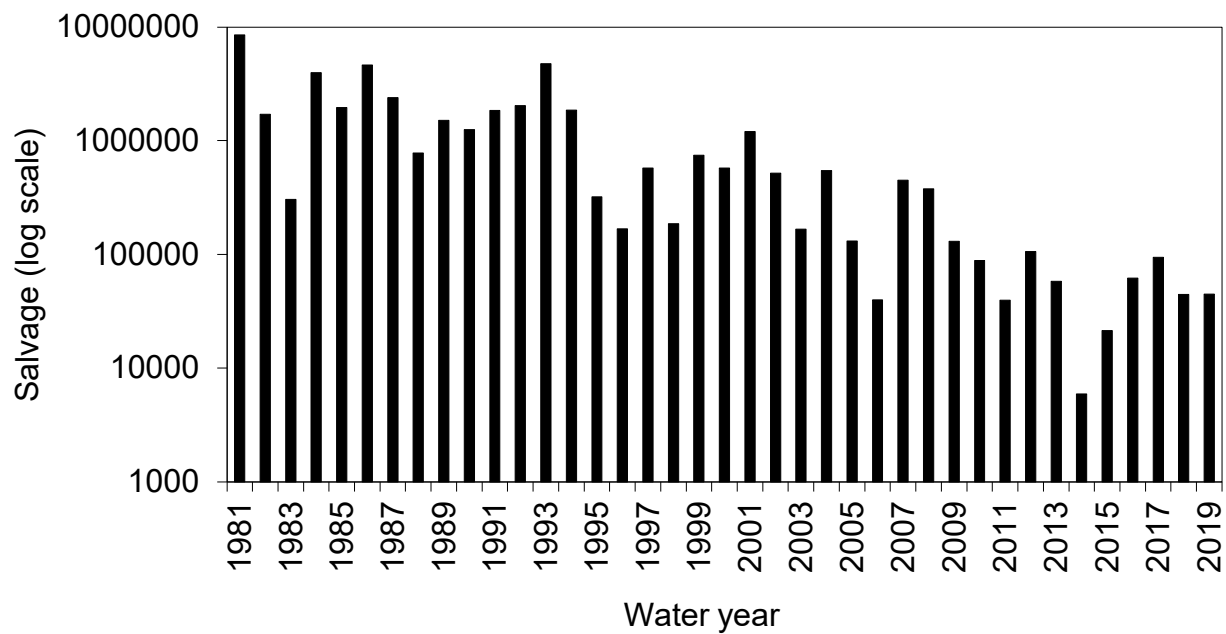


Figure 9. Annual salvage of Striped Bass at the TFCF, WYs 1981–2019

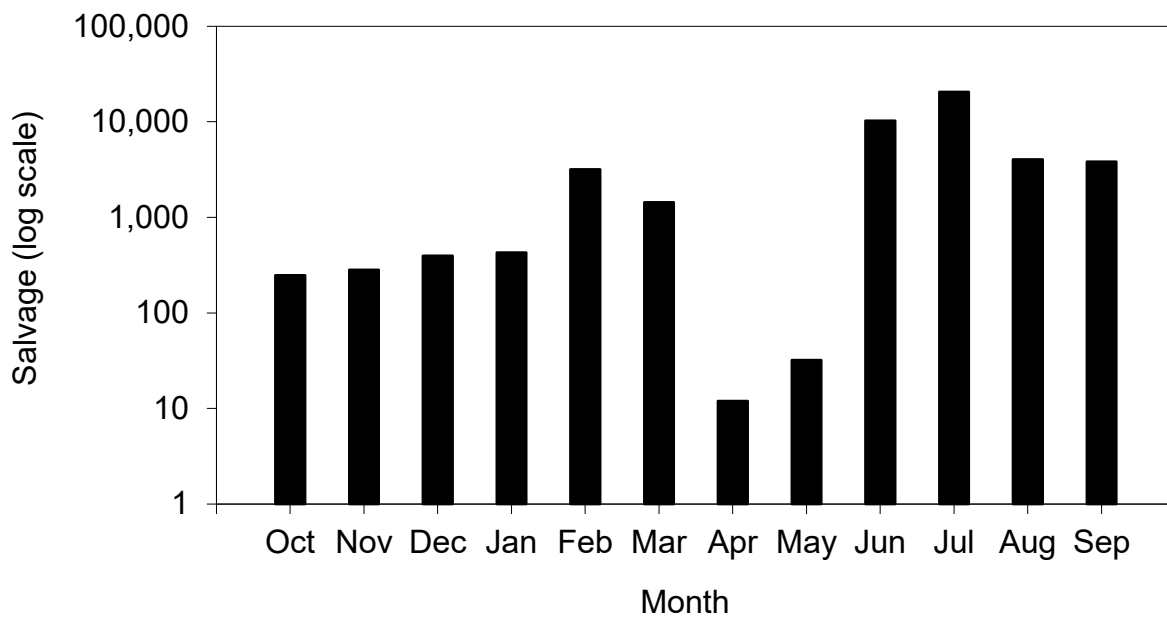


Figure 10. Monthly salvage of Striped Bass at the TFCF, WY 2019

Delta Smelt

Salvage of Delta Smelt was low (8) and a small increase from the record low in WY 2018 (4) but a decrease from WY 2017 (32; Figure 11). Delta smelt salvage has steadily declined since 2005 and has generally followed the same declining annual populations for this species. 2005-2019 was the lowest 15-year period of annual salvage on record (4-1,009).

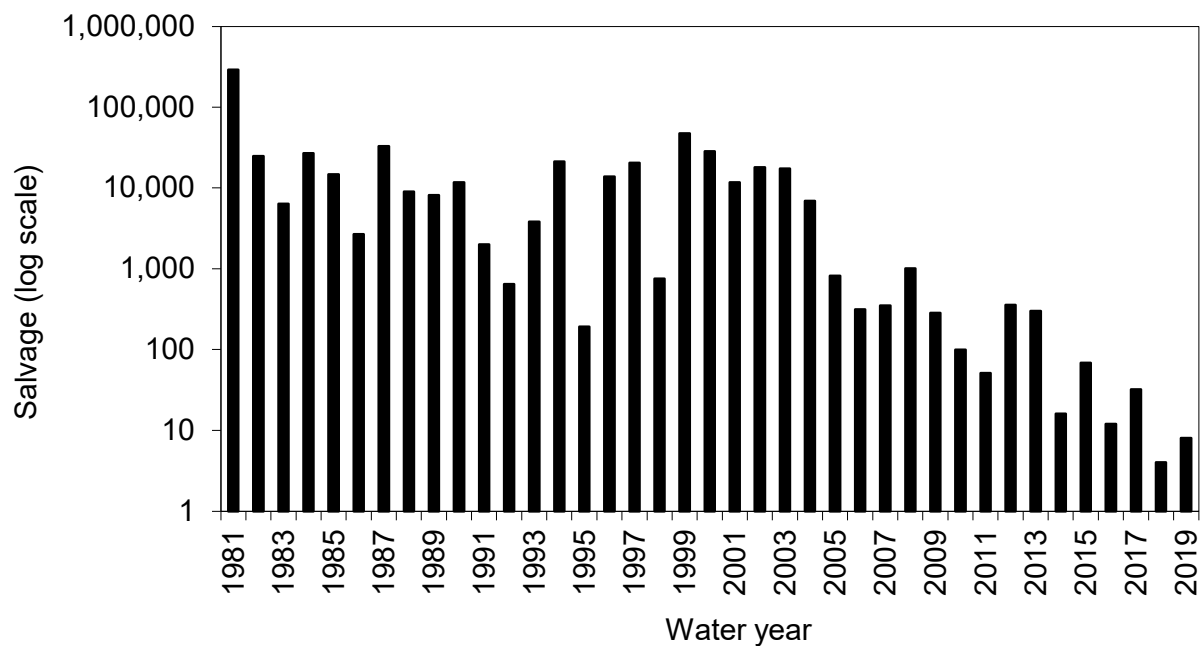


Figure 11. Annual salvage of Delta Smelt at the TFCF, WYs 1981–2019

Adult Delta Smelt were only salvaged on February 25 and March 2. No juvenile Delta Smelt were salvaged in WY 2019. No Delta Smelt less than 20 mm FL were detected in WY 2019, as in WYs 2016-2018.

Longfin Smelt

The salvage of Longfin Smelt (8) was a small increase from the record lows in WY 2018 (0) and WY 2017 (0; Figure 12). 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.

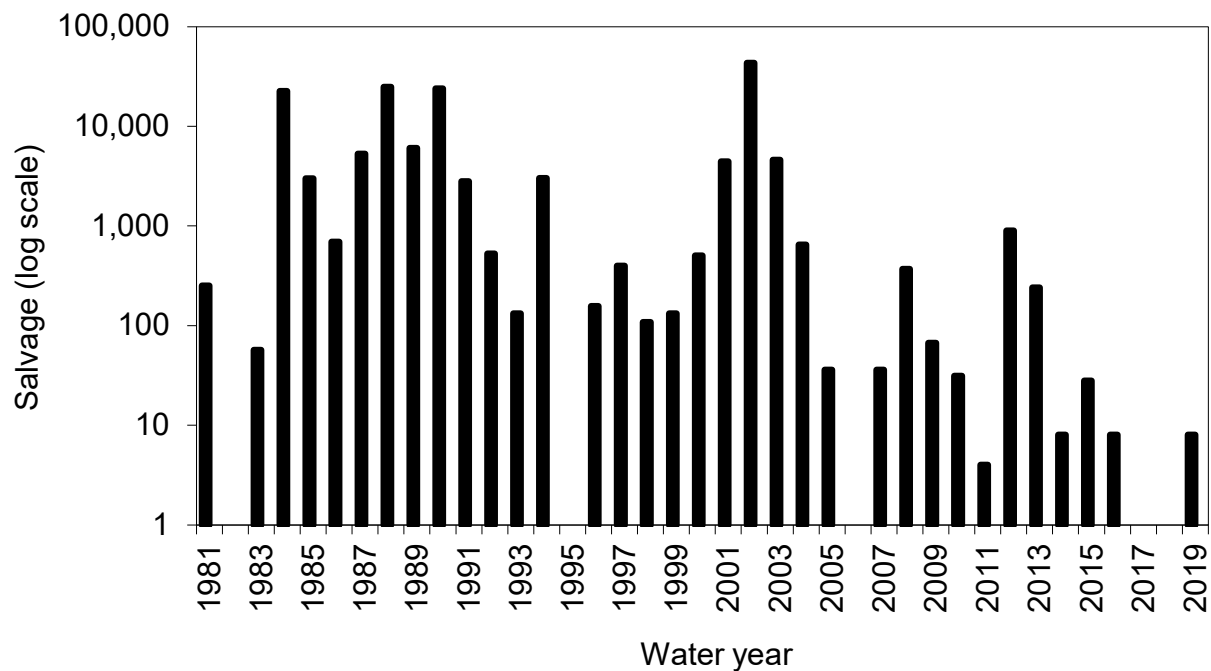


Figure 12. Annual salvage of Longfin Smelt at the TFCF, WYs 1981–2019

Adult Longfin Smelt were only salvaged on February 15. No juvenile Longfin Smelt were salvaged in WY 2019. No Longfin Smelt less than 20 mm FL were detected in WY 2019, which is the same to WY's 2017 and 2018.

Splittail

The salvage of juvenile and adult Splittail (66,962) was a large increase from WY 2018 (7,788), WY 2016 (109), and the record lows in WY 2015 (12) and WY 2014 (12).

However, WY 2019 salvage was a marked decrease from WY 2017 (415,517) and 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.

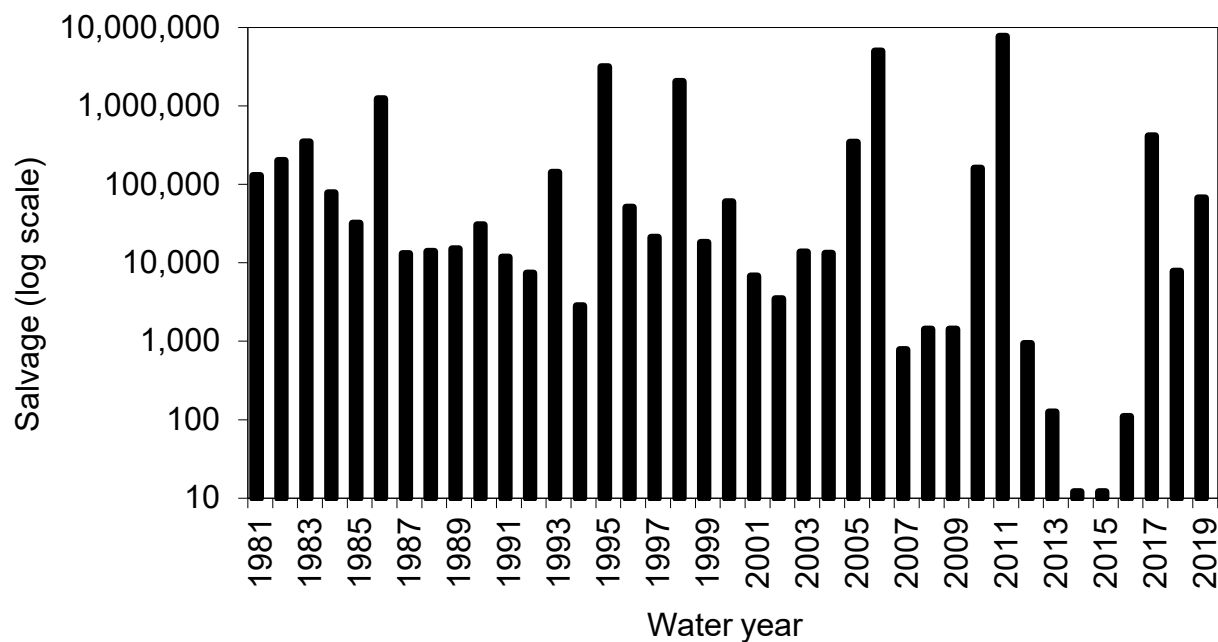


Figure 13. Annual salvage of Splittail at the TFCF, WYs 1981–2019

Threadfin Shad

The salvage of juvenile and adult Threadfin Shad (739,723) was a decrease from WY 2018 (1,068,584) and WY 2016 (1,127,956), but a small increase from WY 2017

(731,760). WY 2019 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 four year period of annual salvage on record (3.5-5.2 million).

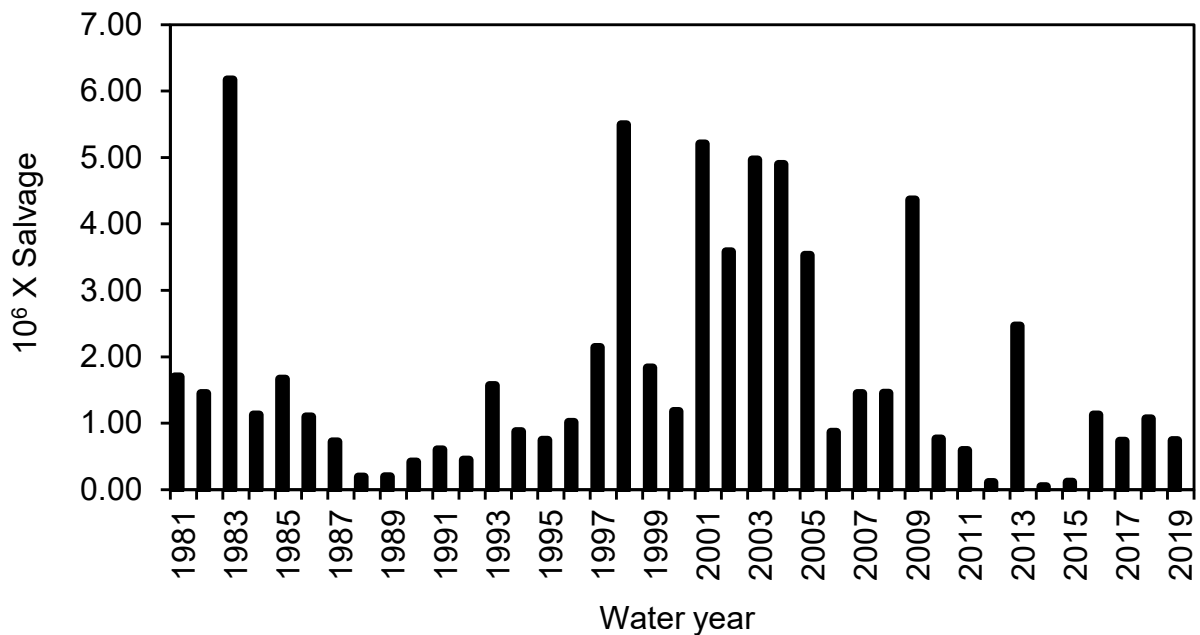


Figure 14. Annual salvage (in millions) of Threadfin Shad at the TFCF, WYs 1981–2019

The monthly salvage of Threadfin Shad in WY 2019 followed the same seasonal trend as observed in past years. The highest salvage of Threadfin Shad occurred in July-August (Figure 15). Threadfin Shad were salvaged every month of the year. Adult Threadfin Shad were mostly salvaged in fall and winter. Juvenile Threadfin Shad were mostly salvaged in summer and fall.

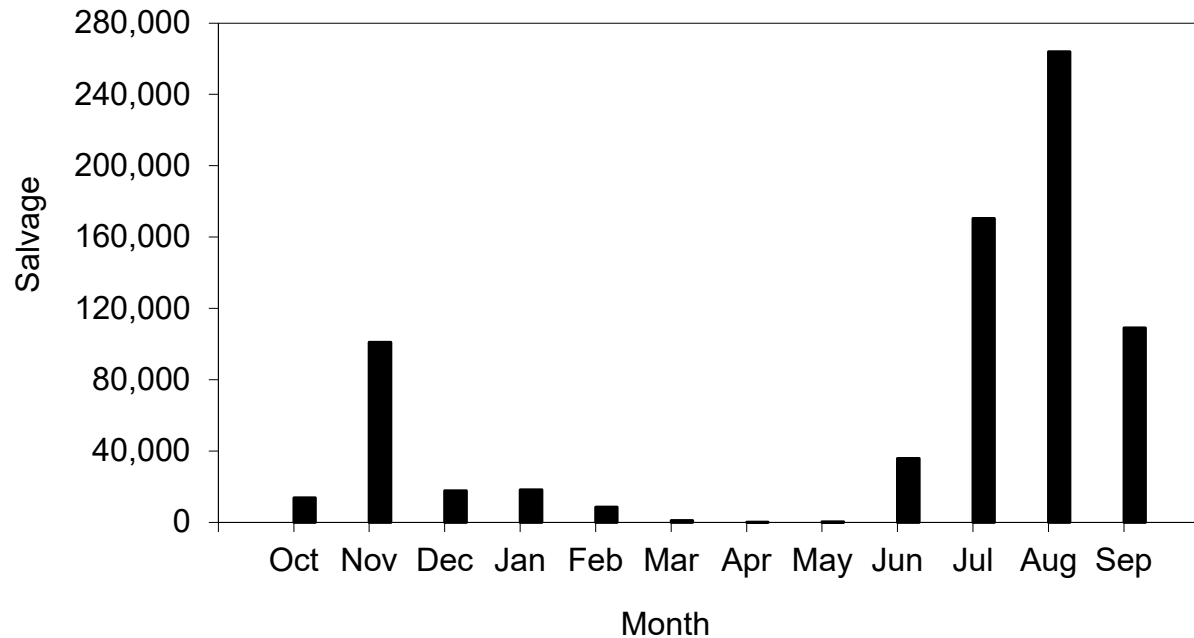


Figure 15. Monthly salvage of Threadfin Shad at the TFCF, WY 2019

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 2019 and 2018

Species	2019		2018	
	Salvage	% Composition	Salvage	% Composition
Threadfin Shad	739,723	50.5	1,068,584	74.6
American Shad	208,897	14.3	88,497	6.2
Bluegill	186,443	12.7	22,813	1.6
White Catfish	68,270	4.7	69,832	4.9
Splittail	66,962	4.6	7,788	0.5
Largemouth Bass	56,224	3.8	62,493	4.4
Striped Bass	44,584	3.0	44,481	3.1
Inland Silverside	16,113	1.1	7,287	0.5
Channel Catfish	13,485	0.9	11,858	0.8
Chinook Salmon	9,083	0.6	14,315	0.1
Common Carp	8,868	0.6	158	<0.1
Black crappie	8,398	0.6	677	<0.1
Prickly Sculpin	7,362	0.5	16,981	1.2
Lamprey Unknown	5,155	0.4	968	<0.1
Golden Shiner	4,498	0.3	707	<0.1
Shimofuri Goby	3,651	0.2	6,928	0.5
Western Mosquitofish	3,551	0.2	296	<0.1
Rainwater Killifish	3,248	0.2	1,516	0.1
Yellowfin Goby	2,920	0.2	4,139	0.3
Redear Sunfish	2,593	0.2	509	<0.1
Red Shiner	1,058	<0.1	12	<0.1
Steelhead	725	<0.1	740	<0.1
Warmouth	629	<0.1	36	<0.1
Brown Bullhead	509	<0.1	96	<0.1
Threespine Stickleback	216	<0.1	113	<0.1
Blue Catfish	175	<0.1	9	<0.1
Black Bullhead	97	<0.1	55	<0.1
Sacramento Pikeminnow	97	<0.1	12	<0.1
Bigscale Logperch	88	<0.1	169	<0.1
Sacramento Sucker	32	<0.1	52	<0.1
Pacific Lamprey	28	<0.1	204	<0.1
White Crappie	24	<0.1	4	<0.1

Appendix A. (Cont.) Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2019 and 2018

Species	2019		2018	
	Salvage	% Composition	Salvage	% Composition
Goldfish	20	<0.1	12	<0.1
Green Sunfish	17	<0.1	12	<0.1
White Sturgeon	16	<0.1	12	<0.1
Delta Smelt	8	<0.1	4	<0.1
Longfin Smelt	8	<0.1	0	0.0
Pacific Staghorn Sculpin	8	<0.1	28	<0.1
Spotted Bass	8	<0.1	0	0.0
Starry Flounder	8	<0.1	76	<0.1
Tule Perch	8	<0.1	4	<0.1
Sacramento Blackfish	4	<0.1	4	<0.1
Shokihaze Goby	4	<0.1	4	<0.1
Fathead Minnow	1	<0.1	0	0.0
Wakasagi	0	0.0	4	<0.1