

Fish Salvage at the Tracy Fish Collection Facility during the 2021 Water Year

by

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Contract Number

R1130005

January 20, 2022

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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 2021 water year (10/1/2020-9/30/2021) operational and biological information gathered from the TFCF. The following species are given individual consideration: Chinook Salmon (*Oncorhynchus tshawytscha*), Steelhead (*O. mykiss*), Striped Bass (*Morone saxatilis*), Delta Smelt (*Hypomesus transpacificus*), Longfin Smelt (*Spirinchus thaleichthys*), Green Sturgeon (*Acipenser medirostris*), Splittail (*Pogonichthys macrolepidotus*), and Threadfin Shad (*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 2021 were noted. Salvage data from WYs 1981 to 2021 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 2021.

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.

Larval fish sampling was conducted during February 15 through June 1 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.

Water Exports

The CVP exported 920,251 acre feet (AF) of water, which was a decrease from WY 2020 (1,968,291 AF), WY 2019 (2,361,826 AF), WY 2018 (2,291,049 AF), WY 2017 (2,679,464 AF), WY 2016 (1,360,026 AF), but an increase from the record low in WY 2015 (695,650 AF; Figure 1). The WY 2021 export, which was a drought year, fell within the range of exports from drought years WYs 2012-2016 (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 2020, February and September 2021 (Figure 2). During these periods, a total of 436,439 AF was exported, accounting for 47.4% of the total export. Monthly exports ranged from 36,349 AF in June to 193,974 AF in October.

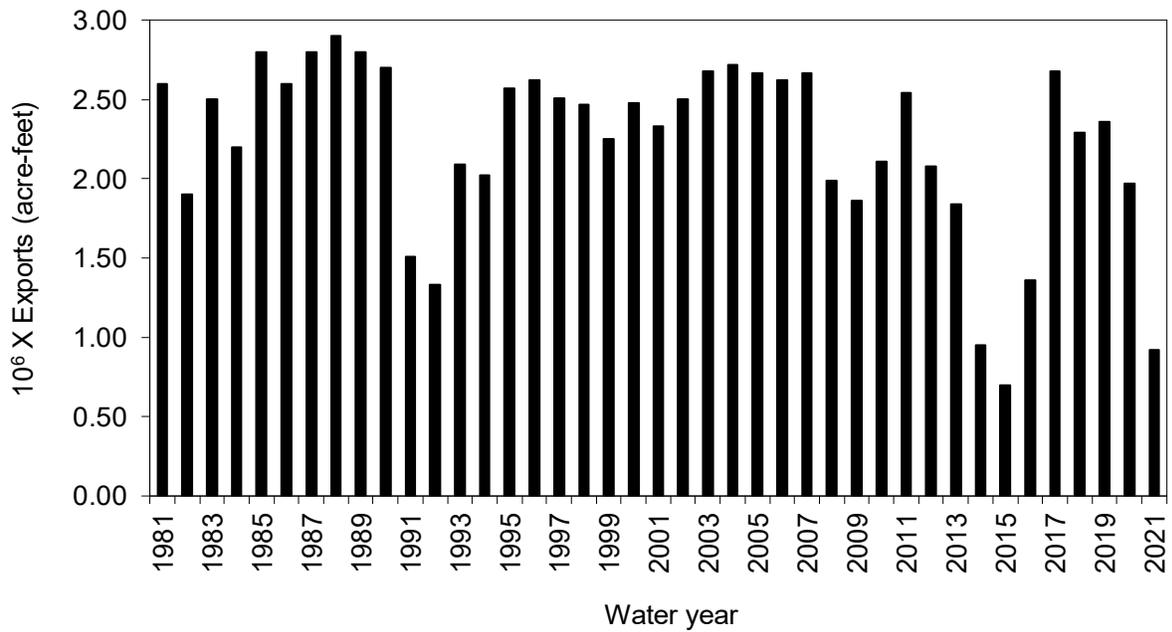


Figure 1. Annual exports (by water year; WY) in millions of acre-feet for the Central Valley Project, WYs 1981–2021.

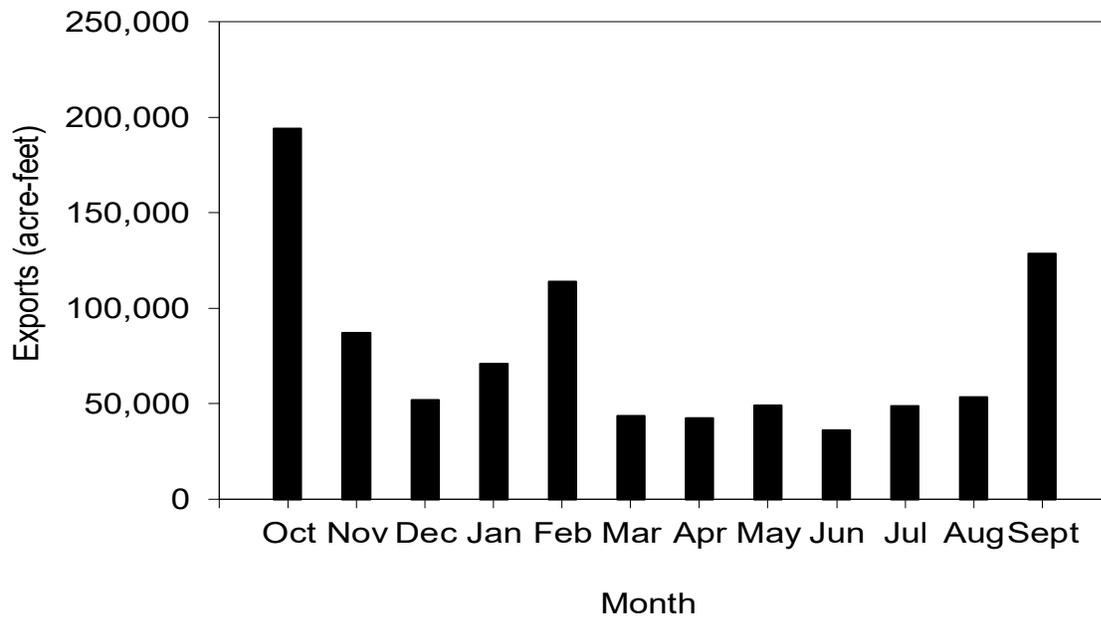


Figure 2. Monthly exports (in acre-feet) for the Central Valley Project, WY 2021

Total Salvage and Prevalent Species

Total fish salvage (all fish combined) at the TFCF was 381,373 (Figure 3). This total was a large decrease from WY 2020 (1,679,609), WY 2019 (1,463,817), and WY 2018 (1,432,489). WY 2021 salvage was an increase from the record low salvage in WY 2014 (160,681). The WY 2021 total was well below the record high salvage of 37,659,835 in WY 2006, most of which were Common Carp.

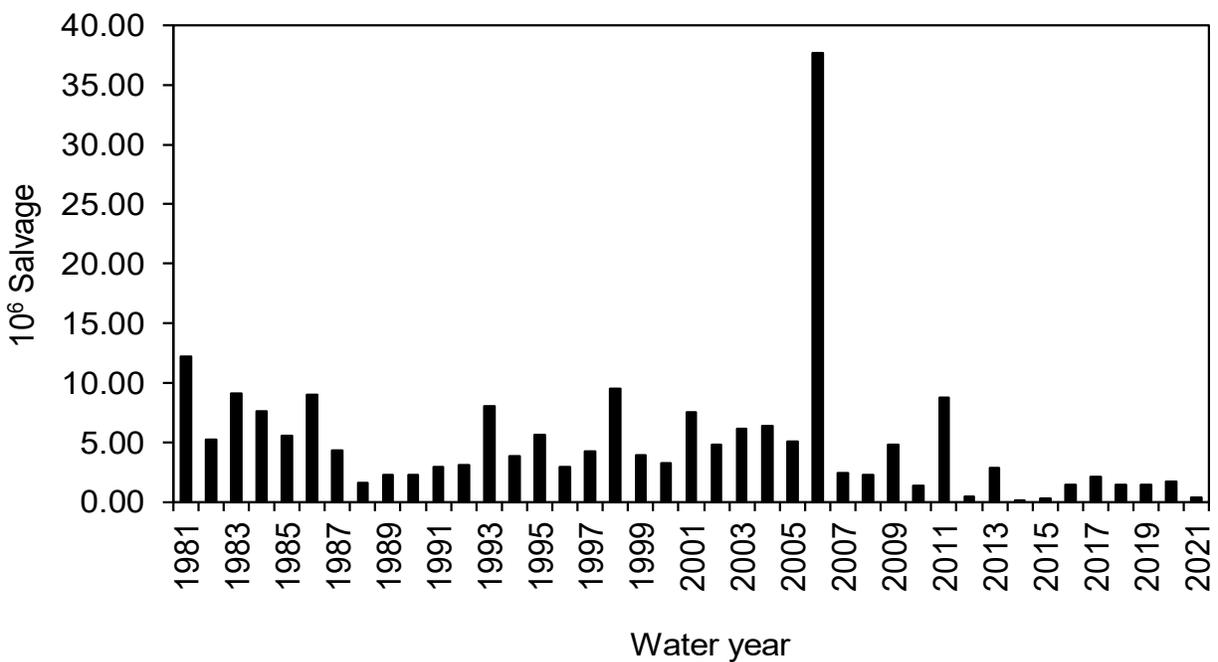


Figure 3. Annual salvage (by water year, WY; in millions) of all fish taxa combined at the TFCF, WYs 1981–2021

Threadfin Shad accounted for 60.0% 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 (15.5%), Largemouth Bass (4.7%),

Shimofuri Goby (3.7%), and White Catfish (3.4%). Native species comprised 2.9% of total fish salvage. This was a small decrease from WY 2020 when native species comprised 3.2% of salvage. Listed species including Chinook Salmon, Steelhead, and Longfin Smelt accounted for 0.3% of salvage. This was equal to WY 2020 when these species and Green Sturgeon also comprised 0.3% of salvage.

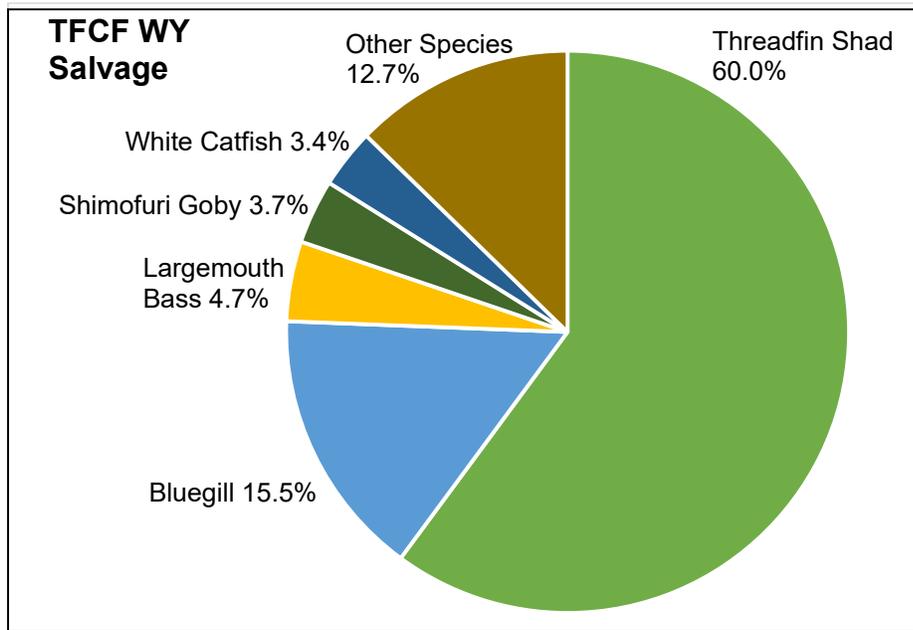


Figure 4. Percentages of annual salvage for the 5 most-prevalent species and other species combined at the TFCF, WY 2021

Chinook Salmon

The annual salvage of juvenile (<300 mm FL) Chinook Salmon was 892 for all races and origins combined (Figure 5; Appendix A). Salvage of Chinook Salmon in WY 2021 was a large decrease from WY 2020 (3,690), WY 2019 (9,083), WY 2018 (14,315) and WY 2017 (23,633), but within the range of WY 2016 (970) and the record low in WY

2015 (187). Mean salvage for WYs 2001-2021 was only 9.9% of the mean salvage for WYs 1981-2000.

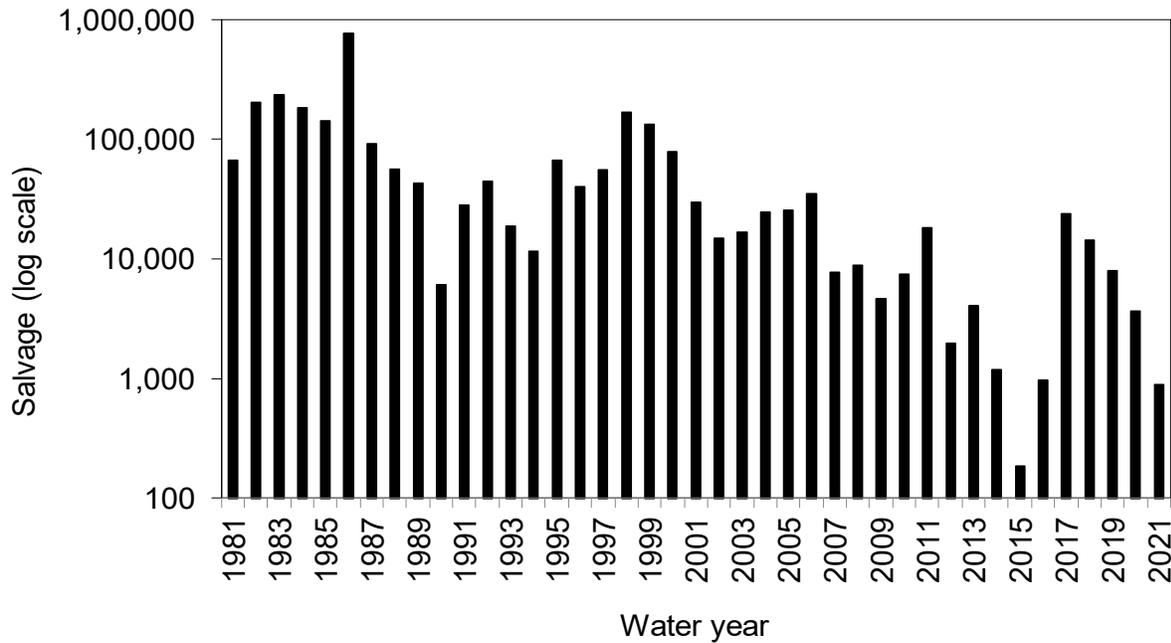


Figure 5. Annual salvage of Chinook Salmon (all races and origins combined) at the TFCF, WYs 1981–2021

Wild Chinook Salmon consisted primarily of fall run fish (98.4%) followed by spring run and winter run fish (Table 1). Wild fall run fish were salvaged in February-May (Figure 6). The largest proportion of wild fall run fish was salvaged in May (296). The estimated loss of wild Chinook Salmon was 751 (Table 1).

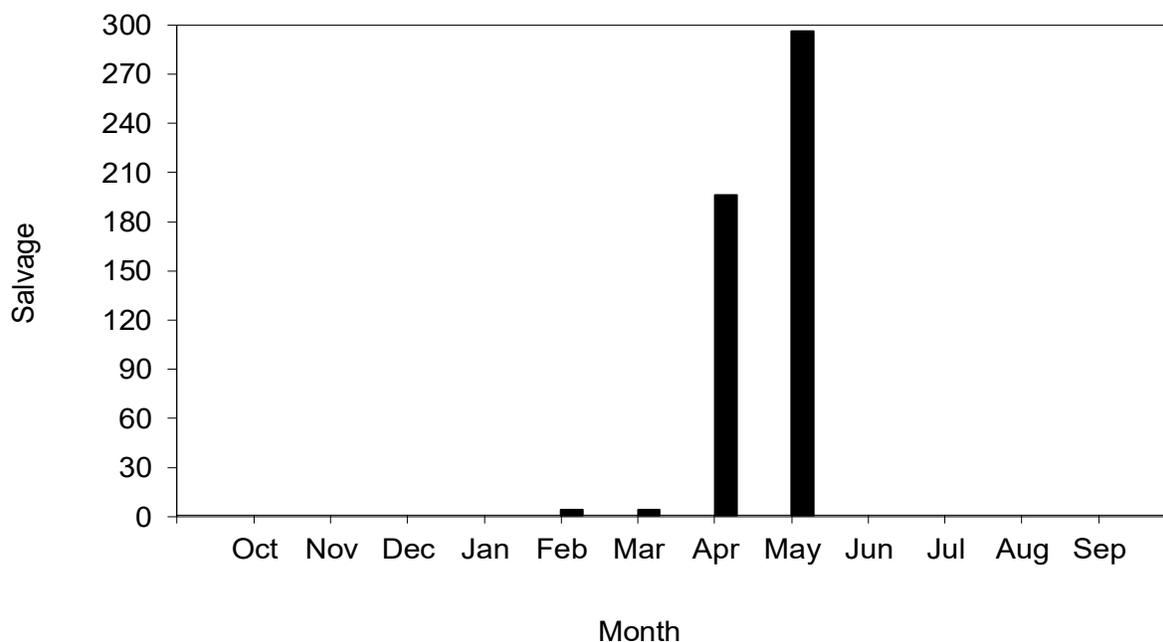


Figure 6. Monthly salvage of wild fall run Chinook Salmon at the TFCF, WY 2021.

Table 1. Chinook Salmon annual salvage, percentages of annual salvage, and losses at the TFCF, WY 2021, by race and origin (wild or hatchery)

<u>Origin</u>	<u>Race</u>	<u>Salvage</u>	<u>Percentage</u>	<u>Loss</u>
Wild	Fall	500	98.4	410
	Late-fall	0	0.0	0
	Spring	4	0.8	3
	Winter	4	0.8	4
Total Wild		508		417
Hatchery	Fall	8	2.1	6
	Late-fall	40	10.4	35
	Spring	332	86.5	290
	Winter	4	1.0	3
Total Hatchery		384		334
Grand Total		892		751

Steelhead

Salvage of wild and hatchery Steelhead (197) was a decrease from WY 2020 (488), WY 2019 (725), and WY 2018 (740), but an increase from the record low in WY 2017 (30), which continued the pattern of mostly low salvage observed since WY 2005 (Figure 7).

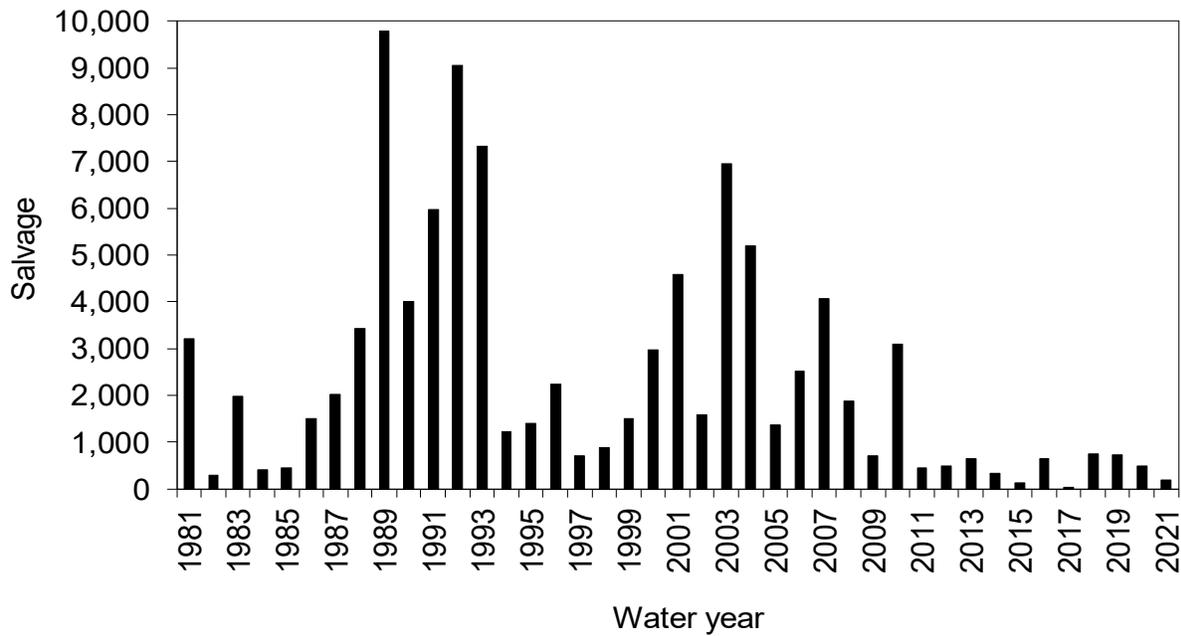


Figure 7. Annual salvage of Steelhead (all origins combined) at the TFCF, WYs 1981–2021

Juvenile Steelhead salvage estimates, as in WYs 2019–2020, were primarily of hatchery origin, which was a shift from WYs 2017–2018 when wild steelhead were most salvaged. The salvage composition was 165 hatchery and 32 wild fish.

Wild Steelhead and hatchery Steelhead were both salvaged in January-May (Figure 8). Hatchery Steelhead were most frequently salvaged in February (81) and wild Steelhead were most frequently salvaged in March-May (8 each month).

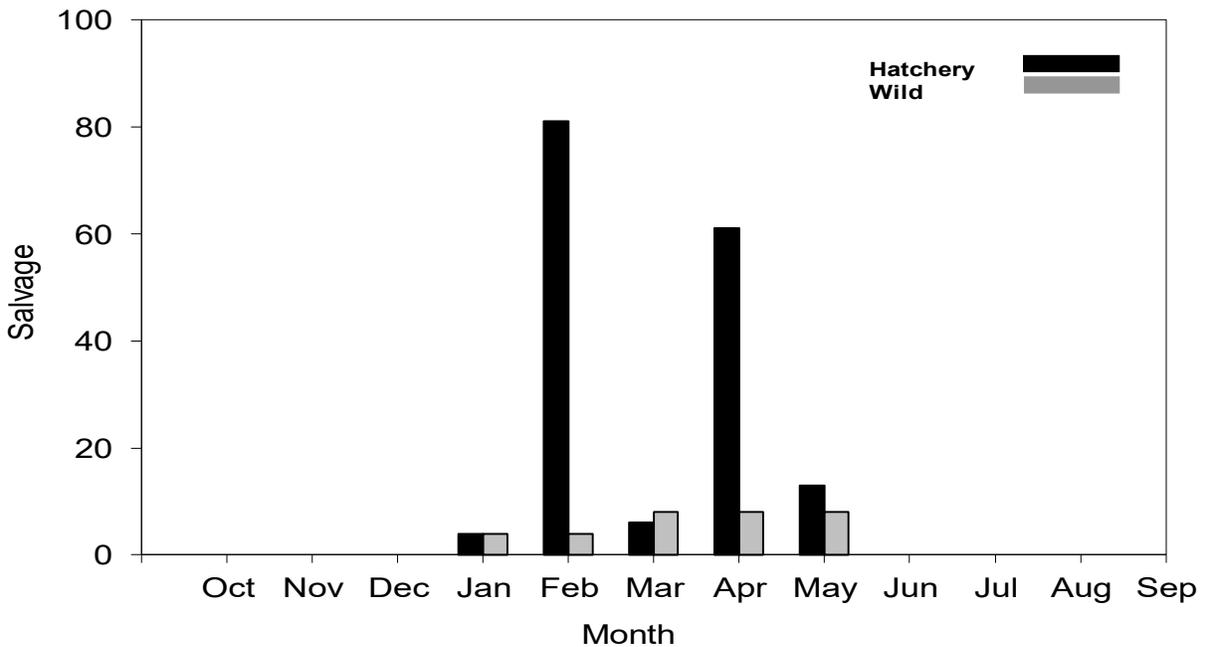


Figure 8. Monthly salvage of hatchery and wild Steelhead at the TFCF, WY 2021

Striped Bass

The annual salvage of juvenile Striped Bass (12,567) 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 May-June (Figure 10). The May salvage (6,065) and June salvage (5,008) accounted for 88.1% of the total salvage. Striped Bass were salvaged every month and the lowest salvage occurred in April (4).

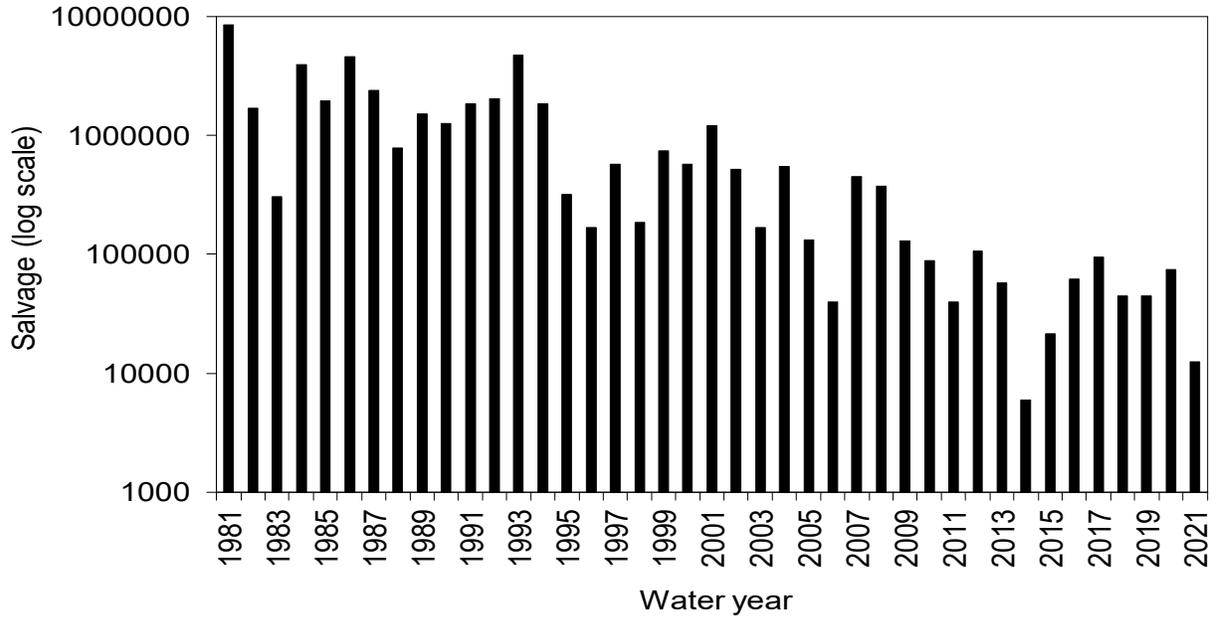


Figure 9. Annual salvage of Striped Bass at the TFCF, WYs 1981–2021

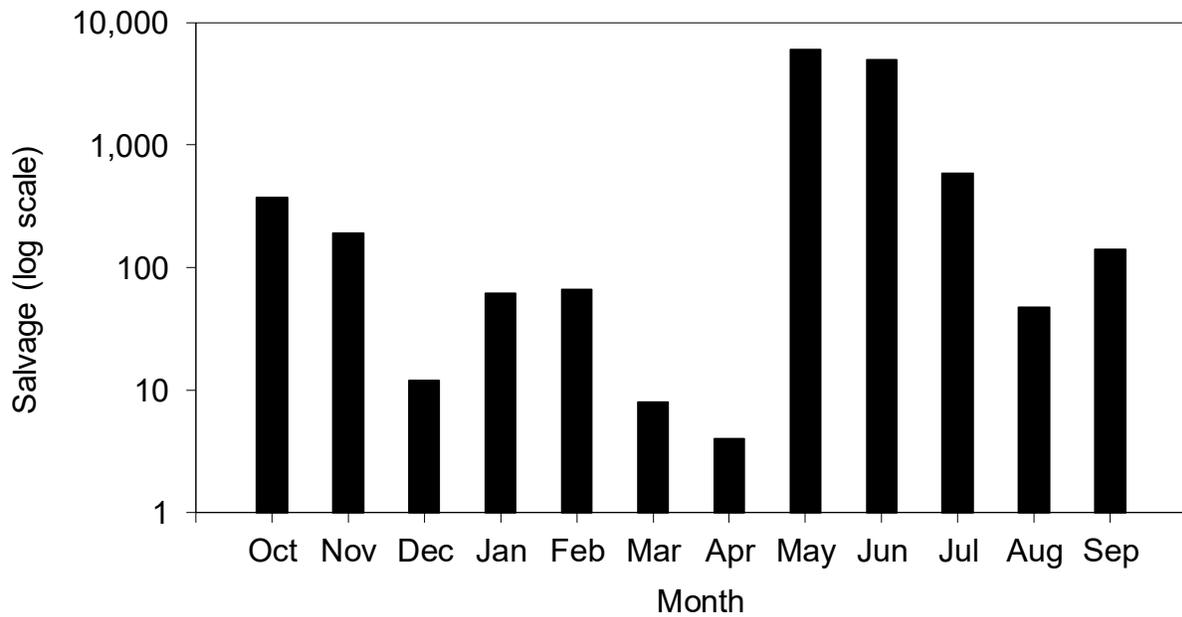


Figure 10. Monthly salvage of Striped Bass at the TFCF, WY 2021

Delta Smelt

No Delta Smelt in WY 2021 were salvaged as in WY 2020 which was a record low and a small decrease from WY 2019 (8) and the previous record low in WY 2018 (4; Figure 11). Delta smelt salvage has steadily declined since 2005 and has generally followed the same declining annual populations for this species. Years 2005-2021 was the lowest 17-year period of annual salvage on record (0-1,009).

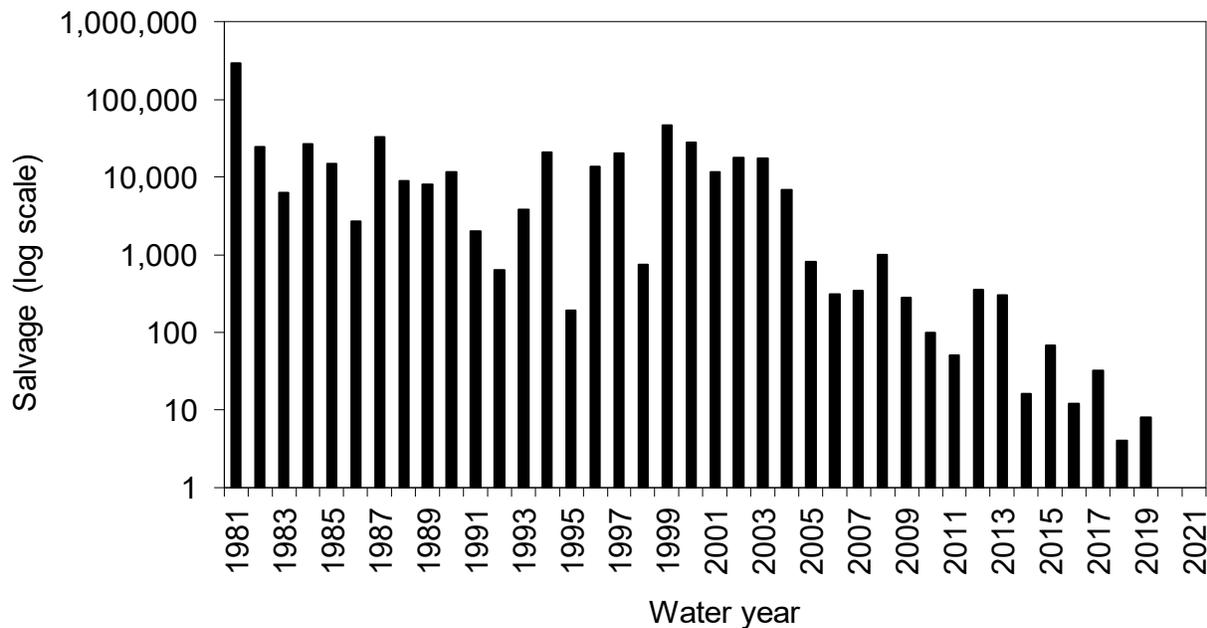


Figure 11. Annual salvage of Delta Smelt at the TFCF, WYs 1981–2021

No Delta Smelt less than 20 mm FL was detected at the TFCF, as in WY's 2016-2019, with the exception of one larva sampled in WY 2020.

Longfin Smelt

Longfin Smelt salvage at the TFCF (188) was a decrease from WY 2020 (1,486), but a large increase from WY 2019 (8) and WYs 2017-18 (0) (Figure 12). The WY 2020

salvage was the largest increase in Longfin Smelt salvage since WYs 2001-2003. 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.

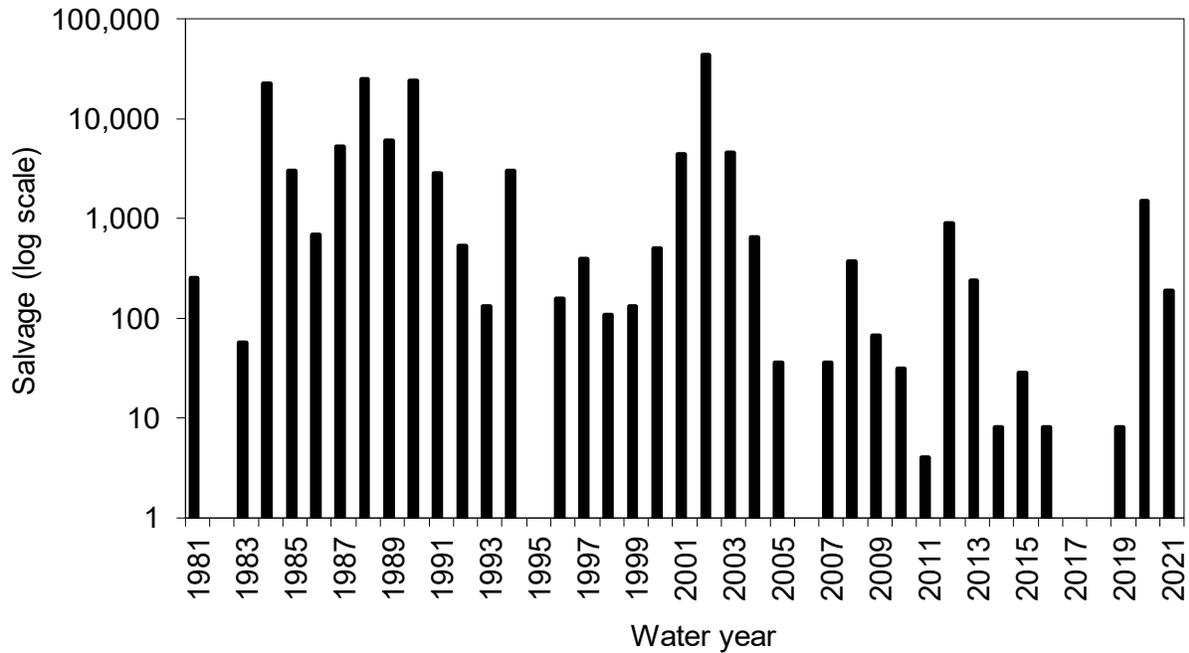


Figure 12. Annual salvage of Longfin Smelt at the TFCF, WYs 1981–2021

Juvenile Longfin Smelt were salvaged during February-May with peak salvage in April (132). No adult Longfin Smelt were salvaged in WY 2021.

Longfin Smelt less than 20 mm FL were detected at the TFCF during 13 dates in February-May, which was a decrease from WY 2020 (18), while none were detected in WYs 2019-2017 (0).

Green Sturgeon

No Green Sturgeon were salvage at the TFCF, which was a decrease from WY 2020 (8), but equal to WYs 2019-2018 (0) (Figure 13). Low annual salvages have generally been observed since 1986. A second distinct decline in salvage was seen since WY 2008.

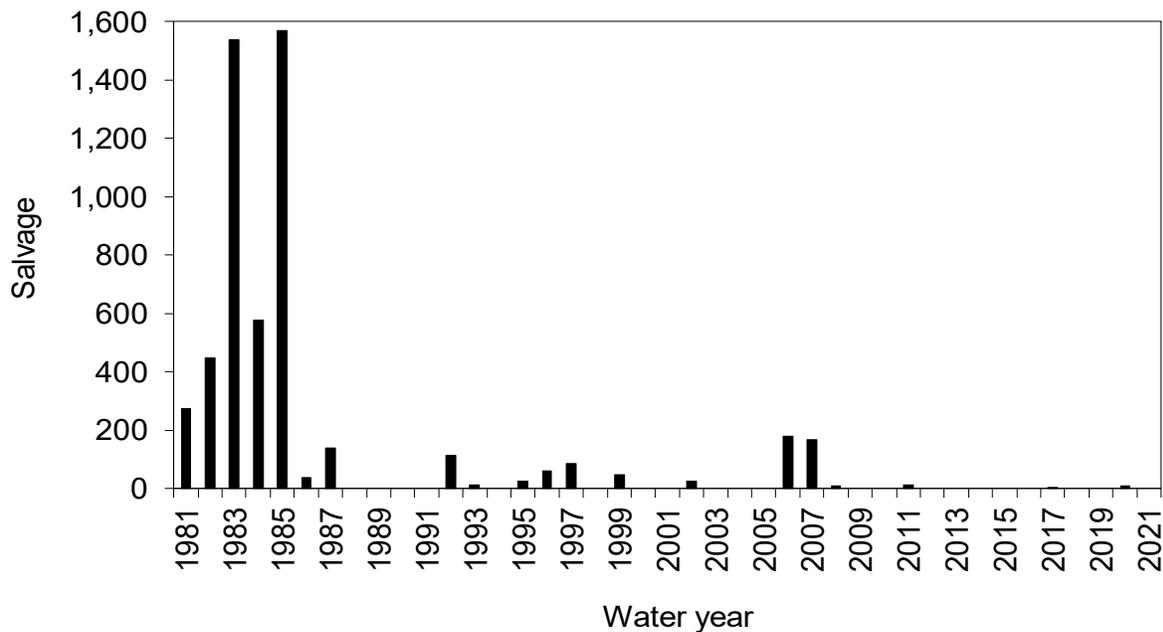


Figure 13. Annual salvage of Green Sturgeon at the TFCF, WYs 1981–2021

Splittail

The salvage of juvenile Splittail (32) was a large decrease from WY 2020 (1,960), WY 2019 (66,962) and WY 2018 (7,788), but within range of salvage in WY 2016 (109), and the record lows in WYs 2014-2015 (12). However, WY 2021 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 14). High Splittail salvage is generally associated with wet years.

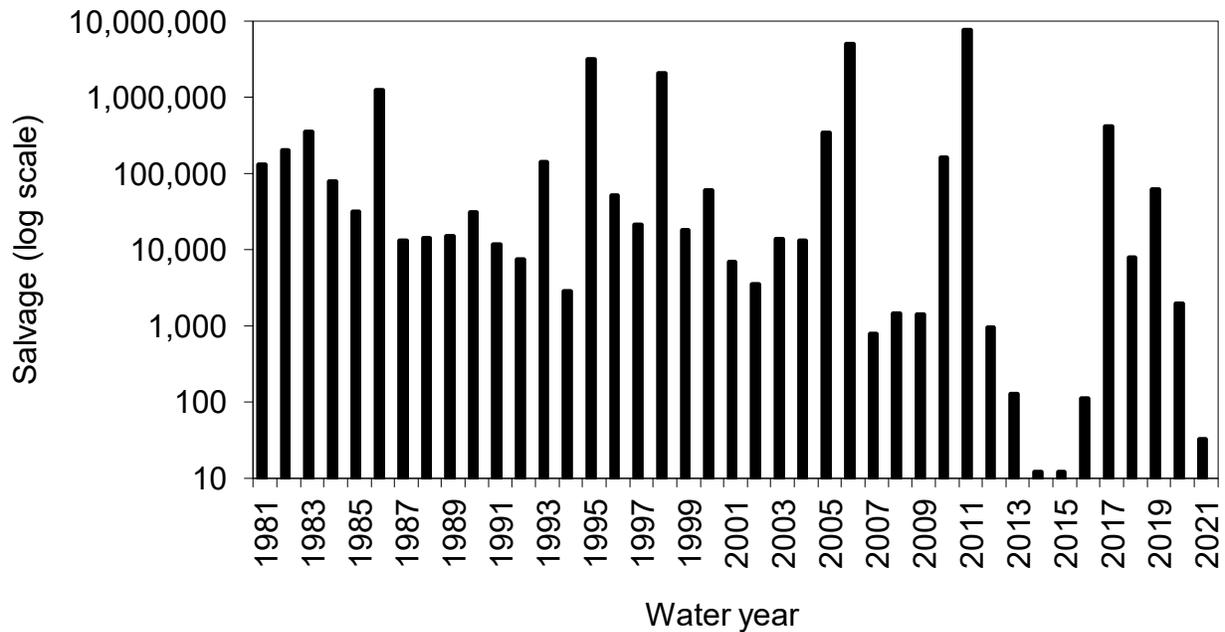


Figure 14. Annual salvage of Splittail at the TFCF, WYs 1981–2021

Threadfin Shad

The salvage of juvenile and adult Threadfin Shad (228,915) was a large decrease from WY 2020 (1,161,551), WY 2019 (739,723), 2018 (1,068,584), and WY 2016 (1,127,956). WY 2020 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 15). Prior to WY 2005, WYs 2001–2004 was the highest four year period of annual salvage on record (3.5–5.2 million).

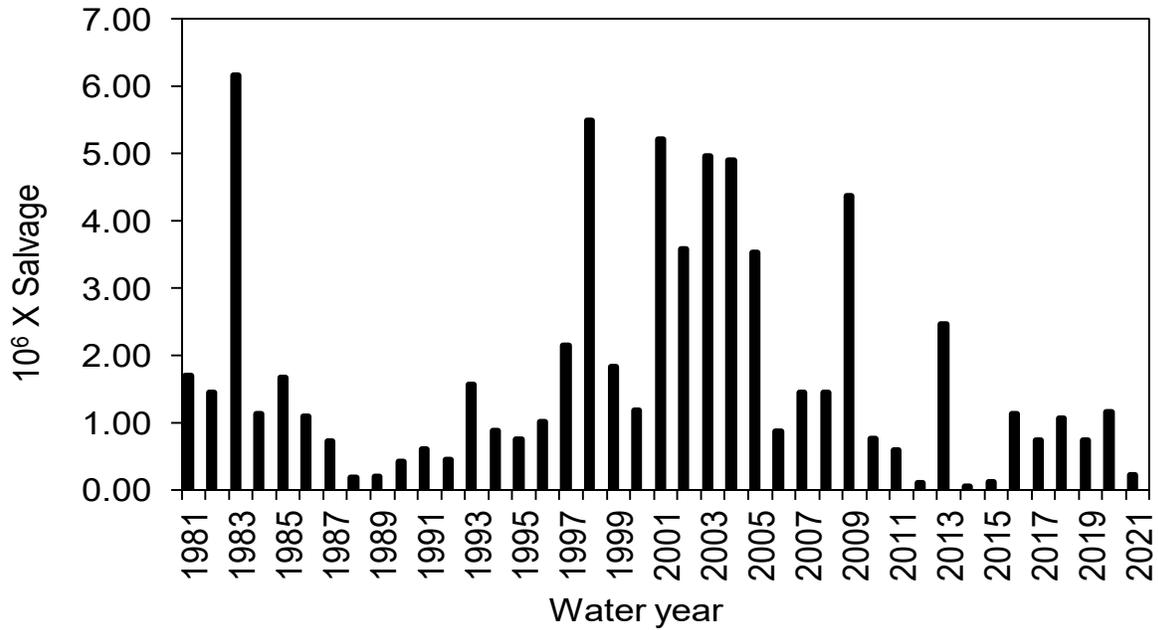


Figure 15. Annual salvage (in millions) of Threadfin Shad at the TFCF, WYs 1981–2021

The monthly salvage of Threadfin Shad in WY 2021 followed the same seasonal trend as observed in past years. The highest salvage of Threadfin Shad occurred in July-September (Figure 16). 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.

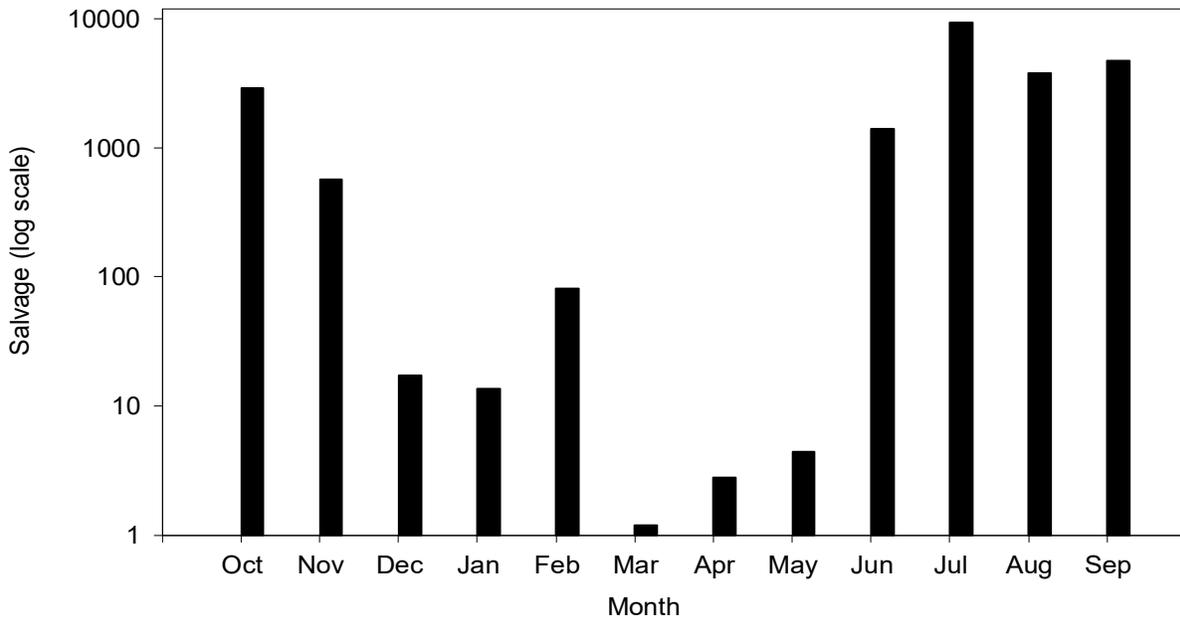


Figure 16. Monthly salvage of Threadfin Shad at the TFCF, WY 2021

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/>

Appendix A. Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2021 and 2020

Species	2021		2020	
	Salvage	% Composition	Salvage	% Composition
Threadfin Shad	228,915	60.0	1,161,551	69.2
Bluegill	58,912	15.5	47,507	2.8
Largemouth Bass	17,697	4.7	120,502	7.2
Shimofuri Goby	14,234	3.7	1,614	<0.1
White Catfish	13,054	3.4	39,833	2.4
Striped Bass	12,567	3.3	74,759	4.5
Inland Silverside	10,572	2.8	15,877	0.9
Prickly Sculpin	7,412	1.9	43,234	2.6
American Shad	5,026	1.3	136,257	8.1
Rainwater Killifish	2,546	0.7	3,772	0.2
Lamprey Unknown	1,768	0.5	2,204	0.1
Yellowfin Goby	1,667	0.4	2,116	0.1
Western Mosquitofish	1,456	0.4	1,182	<0.1
Channel Catfish	944	0.2	11,612	0.7
Chinook Salmon	892	0.2	3,690	0.2
Redear Sunfish	874	0.2	1,781	0.1
Golden Shiner	776	0.2	969	<0.1
Pacific Lamprey	567	0.1	500	<0.1
Black Crappie	528	0.1	4,985	0.3
Steelhead	197	<0.1	488	<0.1
Longfin Smelt	188	<0.1	1,486	<0.1
Red Shiner	144	<0.1	220	<0.1
Bigscale Logperch	140	<0.1	453	<0.1
Threespine Stickleback	76	<0.1	60	<0.1
Brown Bullhead	54	<0.1	76	<0.1
Warmouth	48	<0.1	52	<0.1
Splittail	32	<0.1	1,960	0.1
Black Bullhead	25	<0.1	86	<0.1
Blue Catfish	13	<0.1	22	<0.1
River Lamprey	8	<0.1	0	0.0
Tule Perch	8	<0.1	30	<0.1
Common Carp	5	<0.1	190	<0.1

Appendix A. (Cont.) Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2021 and 2020

Species	2021		2020	
	Salvage	% Composition	Salvage	% Composition
Fathead Minnow	4	<0.1	8	<0.1
Green Sunfish	4	<0.1	0	0.0
Sacramento Sucker	4	<0.1	481	<0.1
Shokihaze Goby	4	<0.1	0	0.0
Smallmouth Bass	4	<0.1	0	0.0
Spotted Bass	4	<0.1	0	0.0
Wakasagi	4	<0.1	32	<0.1
Goldfish	0	0.0	8	<0.1
Green Sturgeon	0	0.0	8	<0.1
Chameleon Goby	0	0.0	4	<0.1