Fish Salvage at the Tracy Fish Collection Facility during the 2023 Water Year

by

Virginia Afentoulis

And

Timothy D. Malinich

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Native Fishes and Fish Facilities and Entrainment Unit

2109 Arch-Airport Road, Suite 100

Stockton, CA 95206

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 released at western Delta sites away from the immediate influence of the export pumps. This report summarizes the 2023 water year (10/1/2022-9/30/2023) 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 2023 were noted. Salvage data from WYs 1981 to 2023 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. Some fish species including Delta Smelt have a low survival rate through the salvage process. Only fish ≥ 20 mm fork length (FL) were numerated (counts), because salvage efficiency degrades rapidly for smaller fish. Salvage estimates were calculated using equations 1 and 2. First by multiplying routine sample counts by an expansion factor; the salvage minutes divided by minutes of the sample count:

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

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

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

Reported 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 2023.

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) and updated using Coded Wire Tag (CWT) and DNA race availability. Chinook Salmon loss estimates are presented to measure the fishery impact of 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) and was subcategorized for Salmon 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 February 15 through June 1 to detect 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 presence of smelt reported the next working day.

Water Exports

The CVP exported 2,220,719-acre feet (AF) of water, which was an increase from WY 2022 (1,406,786 AF), WY 2021 (920,251 AF), and WY 2020 (1,968,291 AF), a slight decrease from WY 2019 (2,361,826 AF), WY 2018 (2,291,049 AF), and WY 2017 (2,679,464 AF), and an increase from WY 2016 (1,360,026 AF) and WY 2015 (695,650 AF; Figure 1). The WY 2023 export, which was an increased rain year, was an increase from the range of exports from recent dry or critical water years 2020-2022 (920,251 to 1,968,291 AF) (as reported on the California Data Exchange Center (CDEC) web page < https://cdec4gov.water.ca.gov/reportapp/javareports?name=WSI>). The highest monthly water exports occurred in January, February, March, May, June, July, August, and September 2023 (Figure 2). During these periods, a total of 1,990,325 AF was exported, accounting for 89.6 % of the total export. Monthly exports ranged from 63,333 AF in October 2022 to 255,815 AF in August 2023.

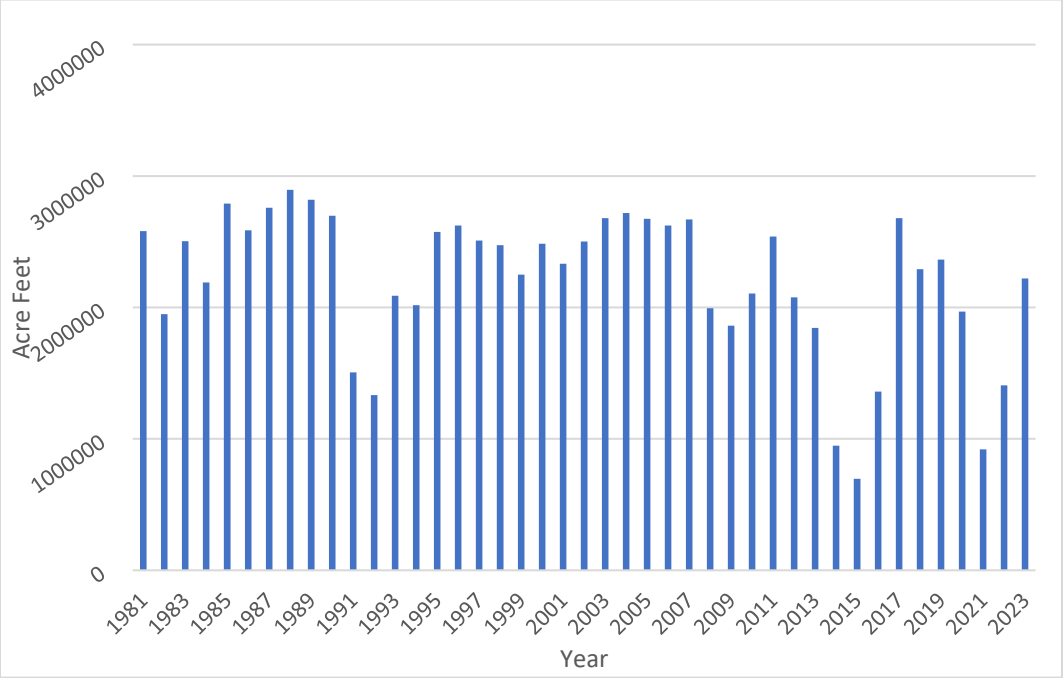

Figure 1. Annual exports (by water year; WY) in millions of acre-feet for the Central Valley Project, WYs 1981–2023.

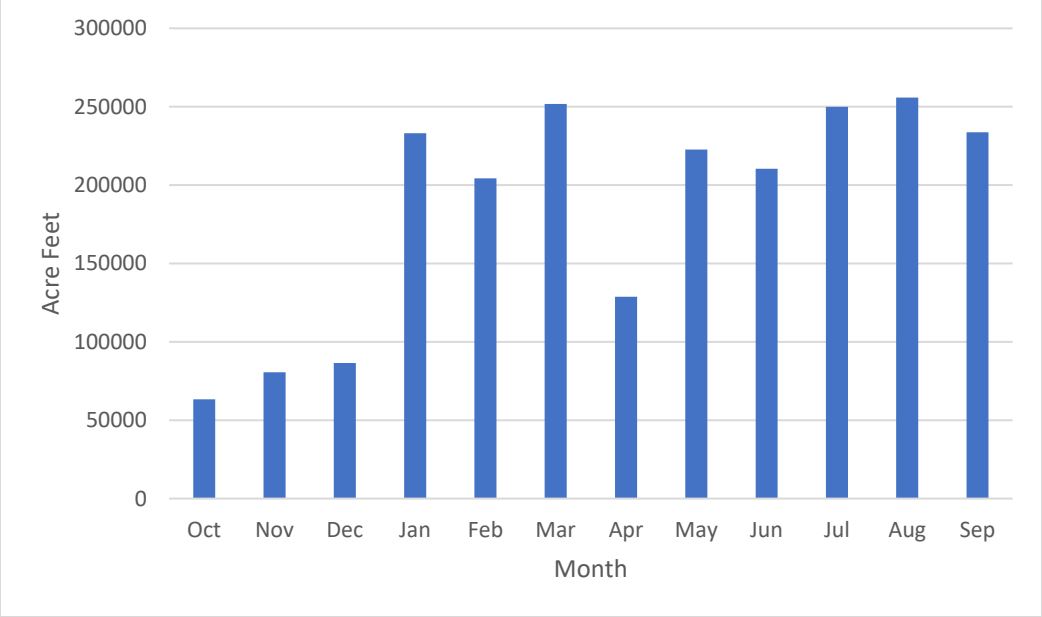

Figure 2. Monthly exports (in acre-feet) for the Central Valley Project, WY 2023

Total Salvage and Prevalent Species

Total fish salvage (all fish combined) at the TFCF was 13,382,124 (Figure 3). This total was a large increase from WY 2022 (1,631,861), 2021 (381,373), 2020 (1,679,609), 2019 (1,463,817), and 2018 (1,432,489). The WY 2023 total, although much higher than drought years, was still below the record high salvage of 37,659,835 in WY 2006, most of which were Common Carp.

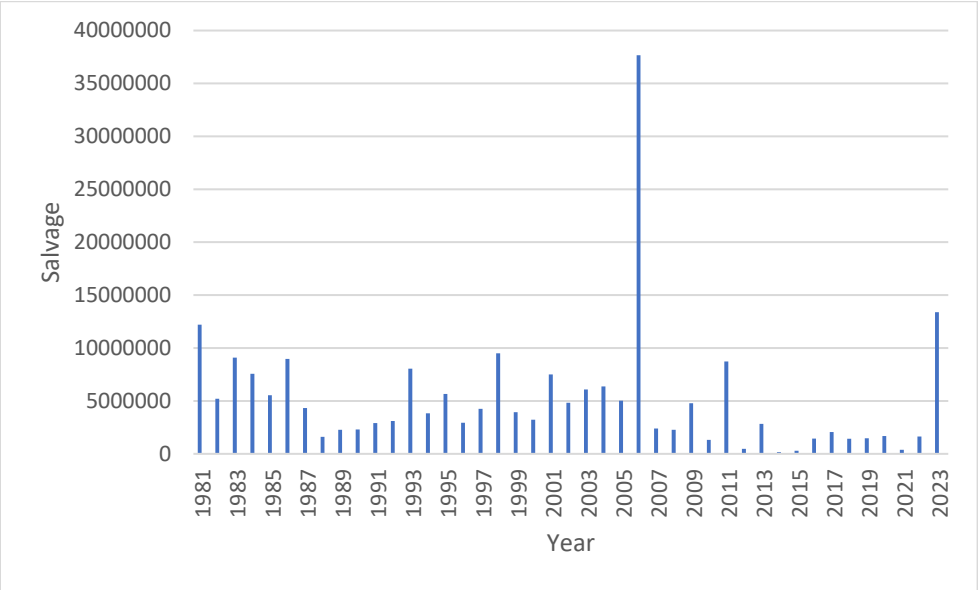

Figure 3. Annual salvage (by water year, WY;) of all fish taxa combined at the TFCF, WYs 1981–2023

Threadfin Shad accounted for 40% 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. Following Threadfin Shad, the most salvaged species were Common Carp (32.5%), Splittail (15.4%), Largemouth Bass (2.6%), and Bluegill (2.0%). Native species

comprised 18.7% of total fish salvage. This was an increase from WY 2022 when native species comprised 0.9% of salvage. Listed species including Chinook Salmon, Steelhead, and Longfin Smelt accounted for 0.2% of salvage. This was a slight decrease from 2022 when these species comprised 0.3% of salvage.

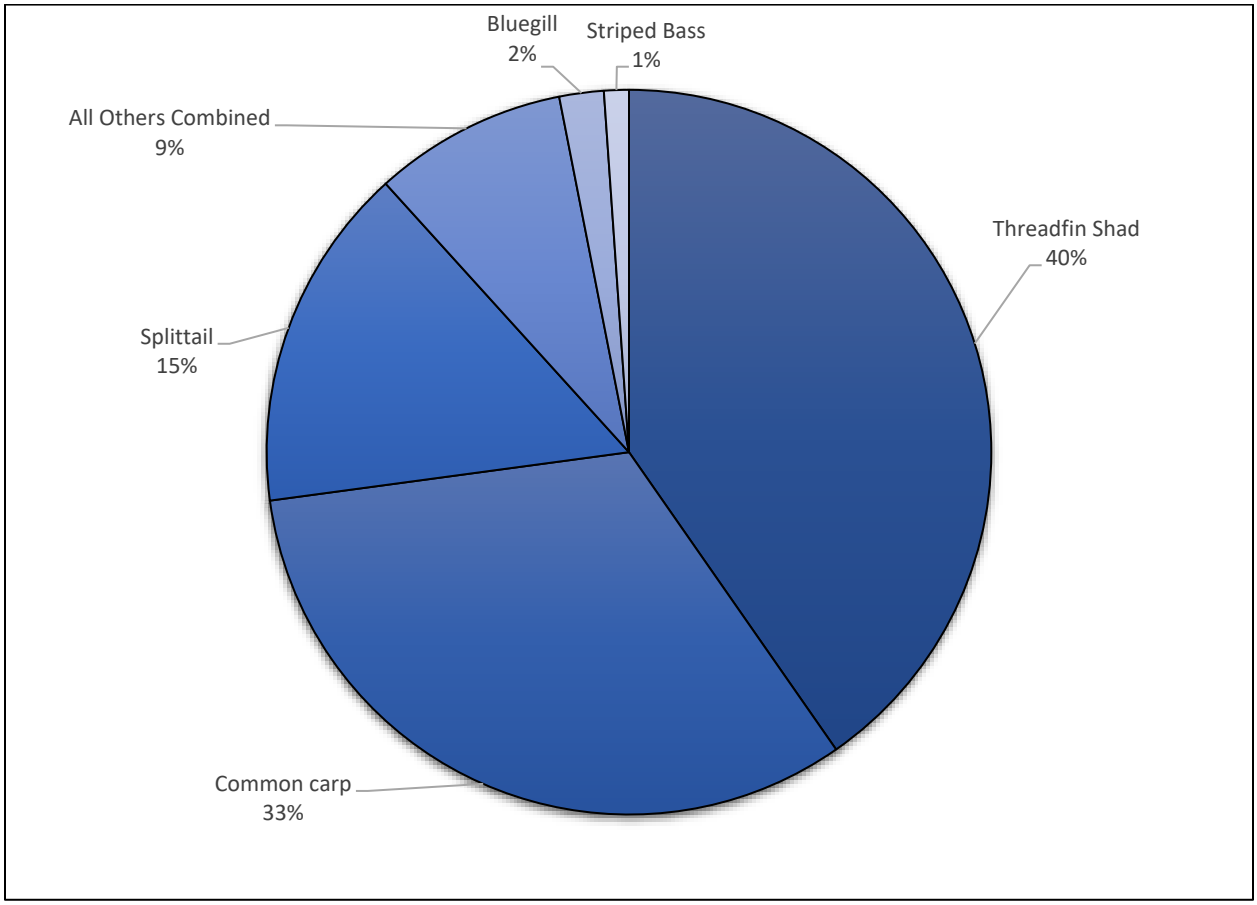

Figure 4. Percentages of annual salvage for the 5 most-prevalent species and other species combined at the TFCF, WY 2023

Chinook Salmon

The annual salvage of juvenile (<300 mm FL) Chinook Salmon was 21,057 for all races and origins combined (Figure 5; Appendix A). Salvage of Chinook Salmon in WY 2023

was a large increase from WY 2022 (1,146), 2021 (892), and WY 2020 (3,690), WY 2019 (9,083), and WY 2018 (14,315). The highest salvage of Chinook Salmon in recent years (since 2015) occurred during WY 2017 (23,633). The record low occurred in WY 2015 (187). Mean salvage for WYs 2001-2023 was only 11.0% of the mean salvage for WYs 1981-2000.

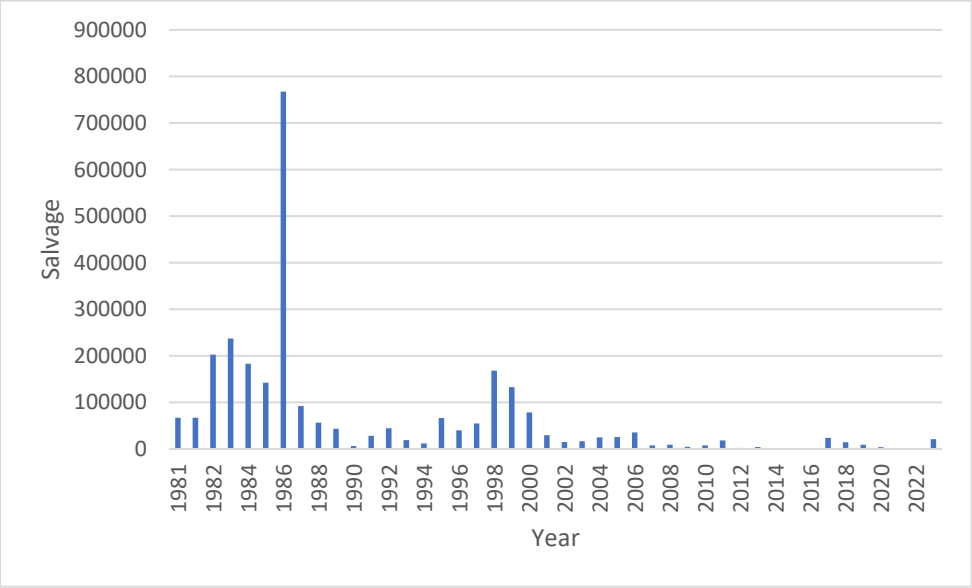

Figure 5. Annual salvage of Chinook Salmon (all races and origins combined) at the TFCF, WYs 1981–2023

Salvaged wild Chinook Salmon at the TFCF were primarily wild fall-run fish, which comprised 97.9% of wild fish caught, followed by wild spring-run fish (Table 1). Wild fall run fish were salvaged in December 2022-September 2023 (Figure 6). The largest proportion of wild fall run fish was salvaged in May (8,139). The estimated loss of wild Chinook Salmon was 14,426 (Table 1).

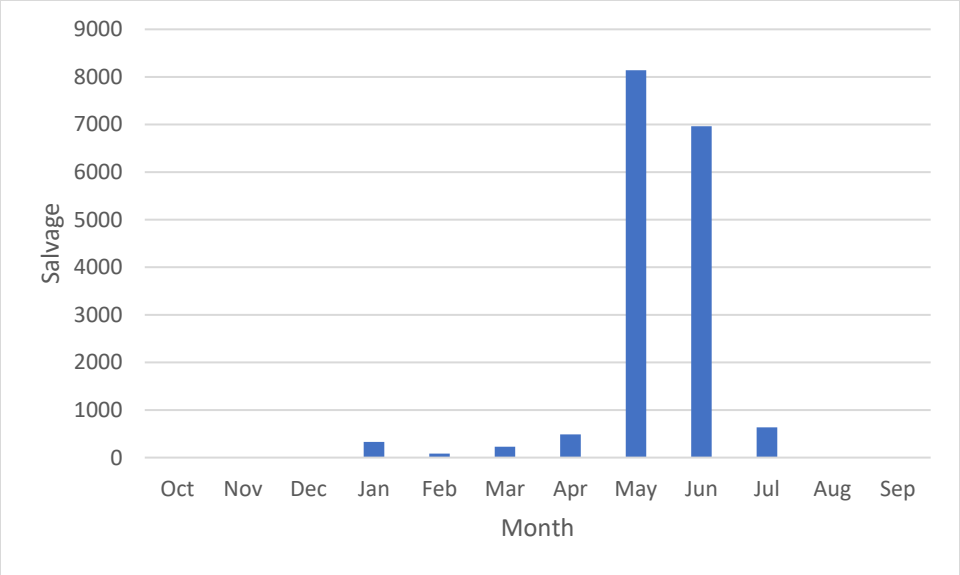

Figure 6. Monthly salvage of wild fall run Chinook Salmon at the TFCF, WY 2023.

Table 1. Chinook Salmon annual salvage, percentages of annual salvage, and losses at the TFCF, WY 2023, by race and origin (wild or hatchery)

Facility	Origin	Race	Salvage	Percentage	Loss
TFCF					
	Wild	Fall	17,484	97.9	11,612
		Late-fall	28	0.1	20
		Spring	344	1.9	259
		Winter	4	<0.1	3
	Total Wild		17,860		11,894
	Hatchery	Fall	40	1.2	33
		Late-fall	372	11.6	275
		Spring	2,797	87.1	2,221
		Winter	4	0.1	3
	Total Hatchery		3,213		2,532
	Grand Total		21,057		14,426

Steelhead

Salvage of steelhead (anadromous Rainbow Trout) was 768 (179-444 mm FL), increasing from WY 2022 (394), and a small increase from WYs 2018-2021 (488-740), but a large increase from the record low in WY 2017 (30) (Figure 7). Most wild steelhead were salvaged in March (63) and included 612 hatchery and 156 wild fish (Figure 8).

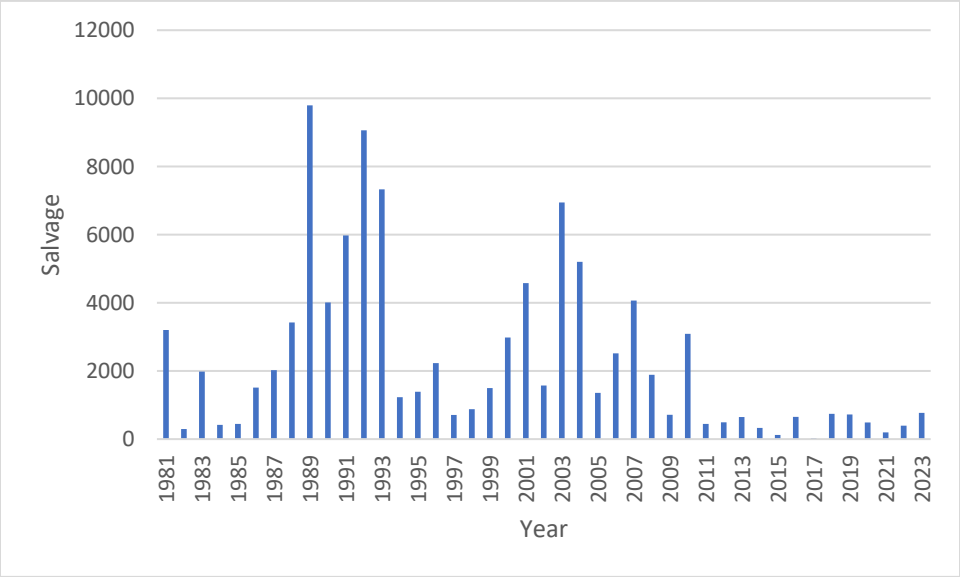

Figure 7. Annual salvage of steelhead (all origins combined) at the TFCF, WYs 1981–2023.

JThe large percentage of hatchery origin juvenile steelhead continues a trend of increased hatchery fish first observed in 2019, whereas during 2017-2019 most steelhead salvaged were wild.

Wild steelhead were salvaged January through March and May and June; and hatchery steelhead were both salvaged in December-April (Figure 8). Hatchery steelhead were most frequently salvaged in February (304)-March (244) and wild steelhead were most frequently salvaged in February (33) -March (63) and May (32), with highest salvaged in March (63).

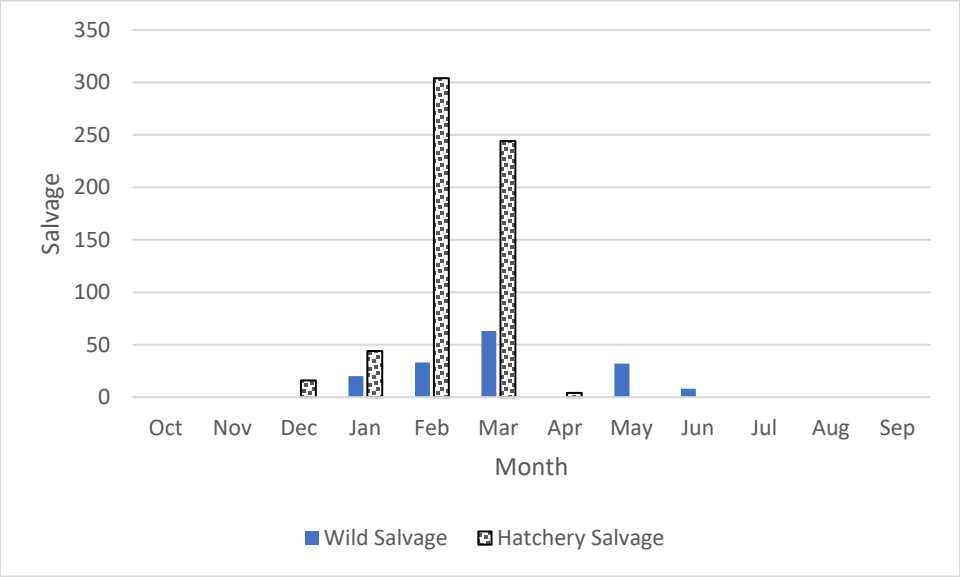

Figure 8. Monthly salvage of hatchery and wild steelhead at the TFCF, WY 2023

Striped Bass

The annual salvage of Striped Bass (20-565 mm FL) mostly juveniles, was 148,037 a large increase from the 2022 total annual salvage (29,706). Similarly, water year 2022 was more than double WY 2021 (12,567). Though this indicates a recent increase, these salvage numbers of Striped Bass continued the low salvage trend observed since WY 1995 (Figure 9). Prior to WY 1995, annual Striped Bass salvage values were above 1,000,000, except for WYs 1983 and 1988.

Most Striped Bass were salvaged in June-Aug (Figure 10). At the TFCF, summer salvage in June (33,797) and July (81,477) accounted for 77.9% of total WY salvage of Striped Bass with the lowest monthly salvage occurring in May.

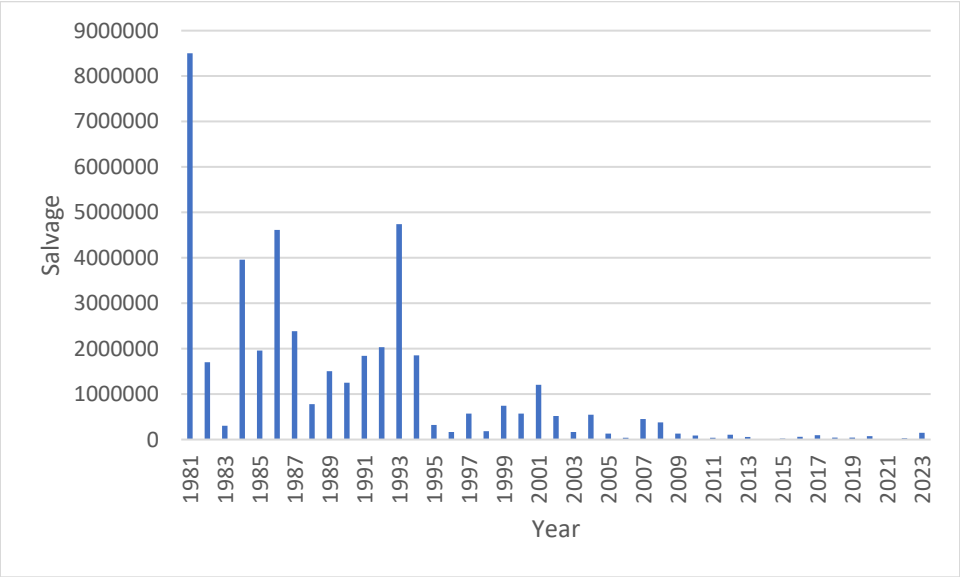

Figure 9. Annual salvage of Striped Bass at the TFCF, WYs 1981–2023

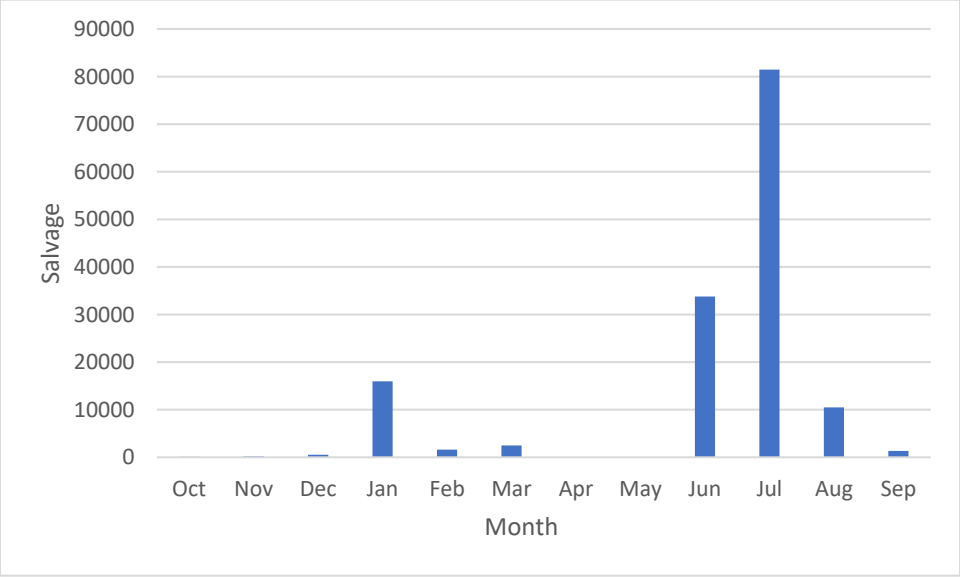

Figure 10. Monthly salvage of Striped Bass at the TFCF, WY 2023

Delta Smelt

Salvage for Delta Smelt (59-76 mm FL) was low (36) but increased from WY 2022 (4). Both years are in contrast to no salvage of Delta Smelt in WY 2021 and WY 2020, which were record lows and a small decrease from WY 2019 (8) and the previous record low in WY 2018 (4) (Figure 11). The salvaged Delta Smelt were of hatchery origin from releases in Winter 2023 with the exception of one unmarked Delta Smelt at TFCF. The last known incidence of Delta Smelt salvage (wild) at TFCF was in WY 2019. Delta smelt salvage has declined since 2005 and the population has also trended downward annually for this species. The 2005-2021 period was the lowest period of annual salvage on record.

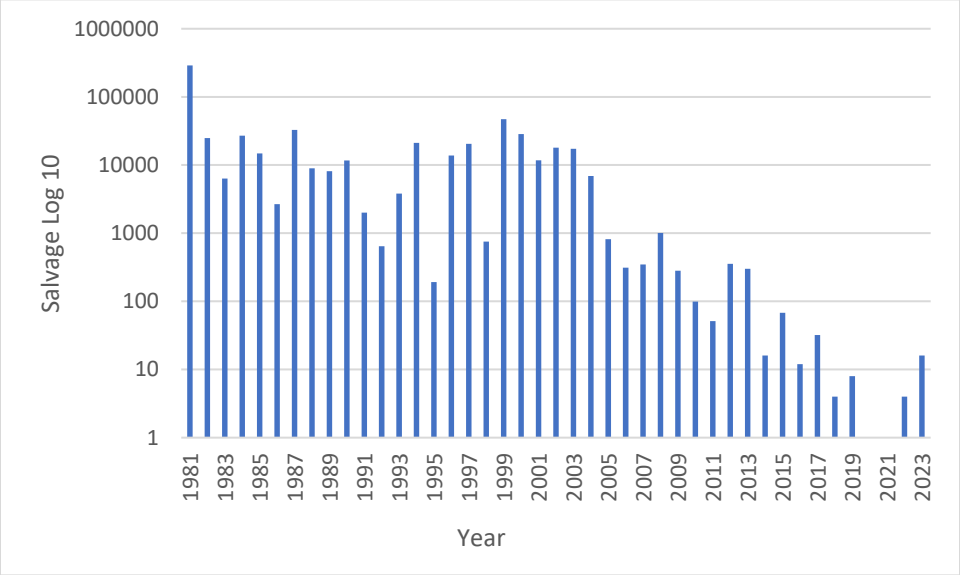

Figure 11. Annual salvage of Delta Smelt at the TFCF, WYs 1981–2023, logarithmic scale on the y-axis.

No Delta Smelt less than 20mm FL were detected at the TFCF in WYs 2016-2019 or 2021-2023, and only one individual was sampled in WY 2020.

Longfin Smelt

Longfin Smelt salvage at the TFCF (20, 74-110mm), was a large decrease from WY 2022 (2,954)which in turn was a sharp increase from 2021 (188) and WY 2020 (1,486). WY 2019 (8) and WYs 2017-18 (0) and WY 2023 are consistent with low annual salvage trends for this species (Figure 12). The WY 2021 salvage was the largest increase in Longfin Smelt salvage since WYs 2001-2020. Low annual salvage has 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.

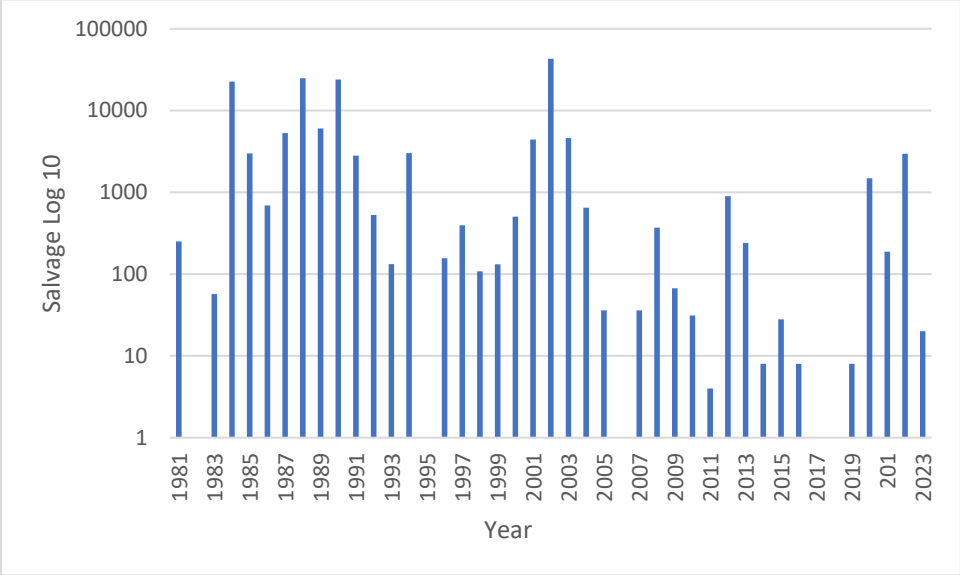

Figure 12. Annual salvage of Longfin Smelt at the TFCF, WYs 1981–2023, logarithmic scale of 10 on the y-axis.

No juvenile Longfin Smelt were salvaged during water year 2023. No Longfin Smelt less than 20 mm FL were detected at the TFCF March-June, which was in contrast to 2022 when they were detected on 31 dates March-April.

Green Sturgeon

No Green Sturgeon were salvaged at the TFCF in WY 2018-2019 and 2021-2023. The last Green Sturgeon salvaged occurred in WY 2020 (8) (Figure 13). Low annual salvage (< 200 individuals) has been observed since 1983 at SDFPF and since 1986 at TFCF.

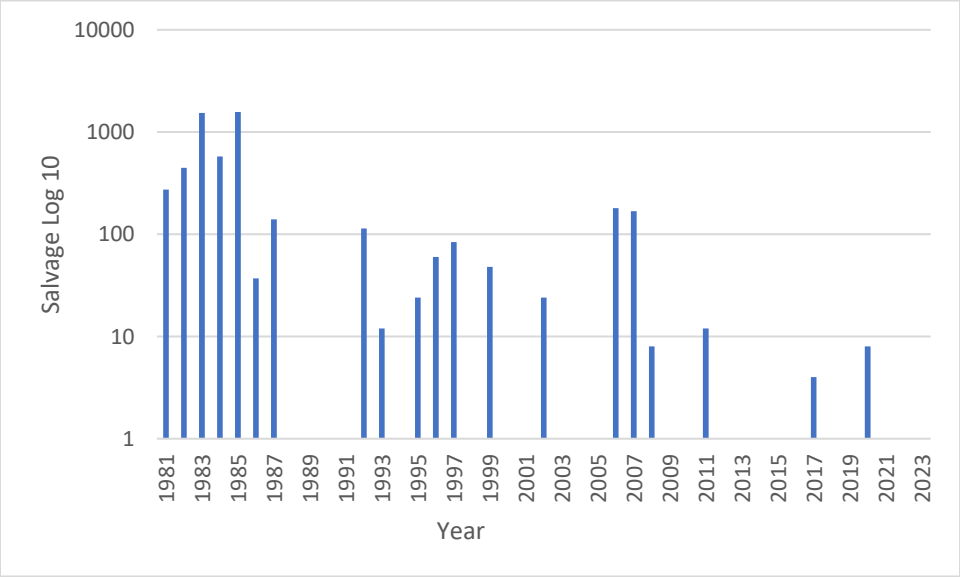

Figure 13. Annual salvage of Green Sturgeon at the TFCF, WYs 1981–2023, logarithmic scale of 10 on y-axis.

Splittail

The salvage of juvenile Splittail (2,063,115) was a sharp increase from WY 2022 (32), and the highest since 2011 (7,660,024). Splittail salvage has followed a boom-or-bust

pattern, varying year to year by several orders of magnitude (Figure 14). High Splittail salvage is generally associated with wet years, including 2023.

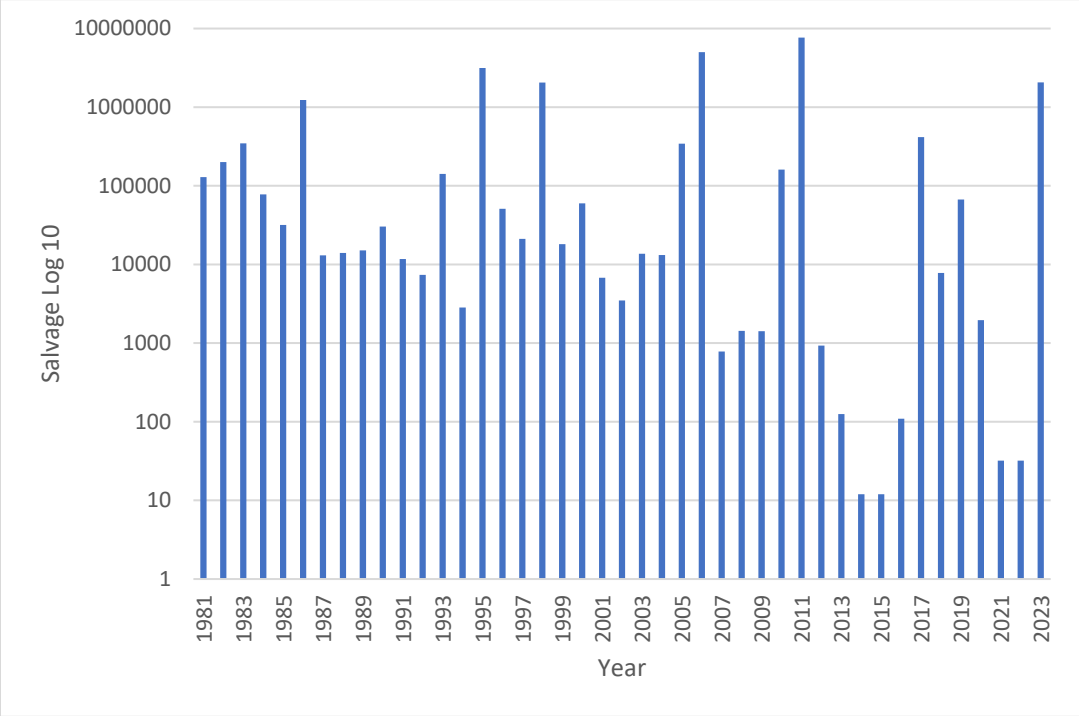

Figure 14. Annual salvage of Splittail at the TFCF, WYs 1981–2023, logarithmic scale of 10 on the y-axis.

Threadfin Shad

The salvage of juvenile and adult Threadfin Shad (5,395,049) in WY 2023 was an increase from WY 2022 (1,358,630) and WY 2021 (228,915) and the highest since 2001 (Figure 15). Similar to Splittail, annual salvage of Threadfin Shad has varied greatly through time (Figure 15). Prior to WY 2006 WYs 2001-2004 was the highest four-year period of annual salvage on record (3.5-5.2 million).

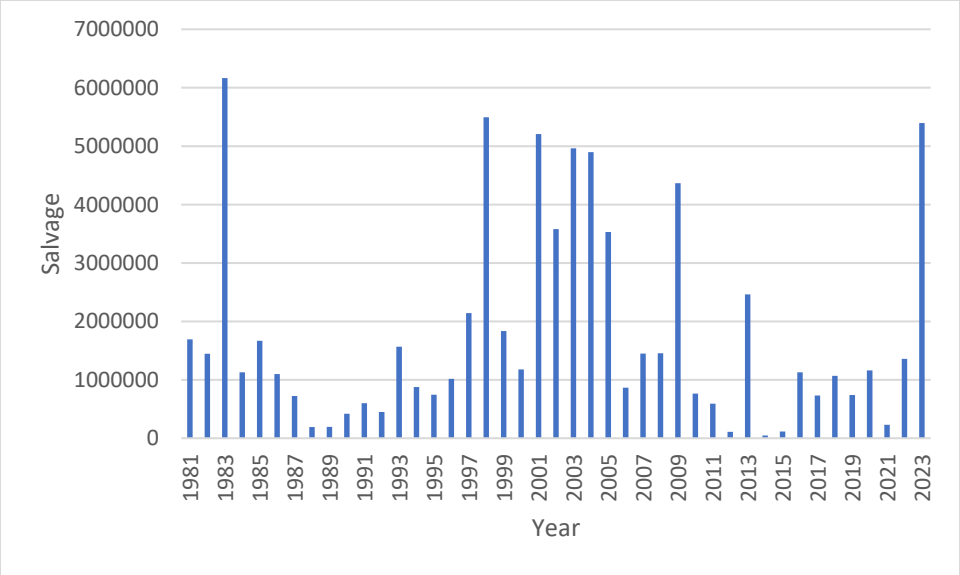

Figure 15. Annual salvage (in millions) of Threadfin Shad at the TFCF, WYs 1981–2023.

The monthly salvage of Threadfin Shad in WY 2023 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.

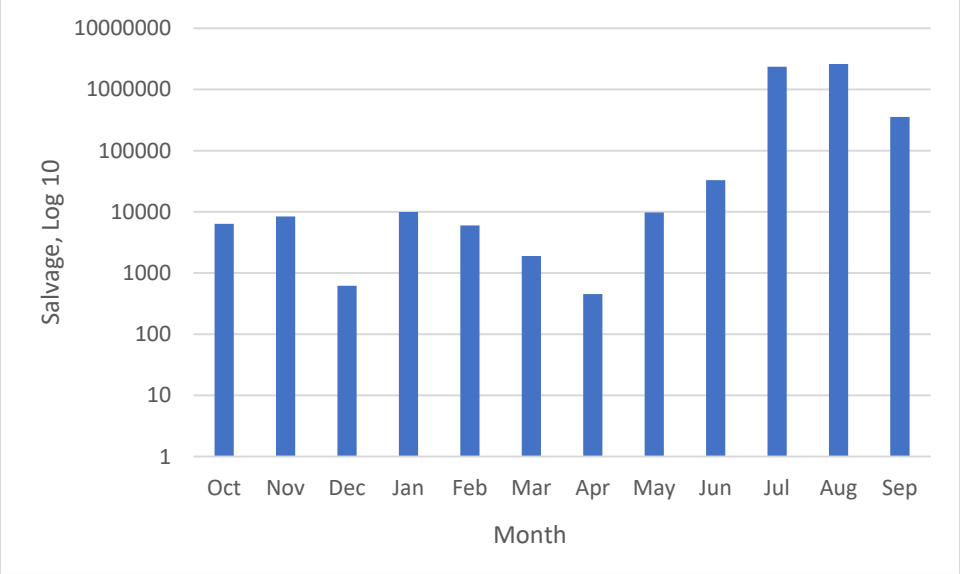

Figure 16. Monthly salvage of Threadfin Shad at the TFCF, WY 2023; the y-axis scale is set to log10.

References

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

Available at: <https://filelib.wildlife.ca.gov/Public/salvage/>

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

Available at: <https://filelib.wildlife.ca.gov/Public/salvage/>

California Data Exchange Center. "California Department of Water Resources." (2015).

Appendix A. Annual salvages and percentages of annual salvage (%) for fish collected from the TFCF in WYs 2022 and 2023.

		2023		2022	
Common Name	**Scientific Name**	**TFCF Salvage**	**TFCF Percent**	**TFCF Salvage**	**TFCF Percent**
Threadfin Shad	*Dorosoma petenense*	5,395,049	40.3	1,358,630	83.3
Common Carp	*Cyprinus carpio*	4,355,824	32.5	4	<0.1
Splittail	*Pogonichthys macrolepidotus*	2,063,115	15.4	32	<0.1
Largemouth Bass	*Micropterus salmoides*	353,832	2.6	52,263	3.2
Bluegill	*Lepomis macrochirus*	265,242	2.0	104,805	6.4
White Catfish	*Ameiurus catus*	263,668	2.0	15,144	0.9
Striped Bass	*Morone saxatilis*	148,037	1.1	29,706	1.8
Black Crappie	*Pomoxis nigromaculatus*	110,568	0.8	1,315	<0.1
Lamprey Unknown	*Lampetra*	79,604	0.6	1,612	<0.1
Channel Catfish	*Ictalurus punctatus*	76,952	0.6	1,324	<0.1
American Shad	*Alosa sapidissima*	62,657	0.5	18,279	1.1
Sacramento Sucker	*Catostomus occidentalis*	55,020	0.4	4	<0.1
Inland Silverside	*Menidia beryllina*	33,065	0.2	9,090	0.6
Redear Sunfish	*Lepomis microlophus*	26,158	0.2	2,877	0.2
Chinook Salmon	*Oncorhynchus tshawytscha*	21,057	0.2	1,146	<0.1
Shimofuri Goby	*Tridentiger bifasciatus*	14,344	0.1	7,634	0.5
Golden Shiner	*Notemigonus crysoleucas*	13,288	0.1	2,739	0.2
Prickly Sculpin	*Cottus asper*	10,175	0.1	7,959	0.5

Appendix A (continued).

		2023		2022	
Common Name	**Scientific Name**	**TFCF Salvage**	**TFCF Percent**	**TFCF Salvage**	**TFCF Percent**
Rainwater Killifish	*Lucania parva*	9,366	0.1	5,511	0.3
Yellowfin Goby	*Acanthogobius flavimanus*	7,788	0.1	4,952	0.3
Western Mosquitofish	*Gambusia affinis*	5,569	<0.1	1,238	<0.1
Threespine Stickleback	*Gasterosteus aculeatus*	2,907	0.0	208	<0.1
Red Shiner	*Cyprinella lutrensis*	1,755	<0.1	110	<0.1
Warmouth	*Lepomis gulosus*	1,560	<0.1	247	<0.1
White Sturgeon	*Acipenser transmontanus*	945	<0.1	0	0.0
Black Bullhead	*Ameiurus melas*	919	0.0	54	<0.1
Bigscale Logperch	*Percina macrolepida*	792	<0.1	261	<0.1
steelhead	*Oncorhynchus mykiss*	768	0.0	394	<0.1
Tule Perch	*Hysterocarpus traskii*	654	0.0	28	<0.1
Goldfish	*Carassius auratus*	437	<0.1	4	<0.1
Brown Bullhead	*Ameiurus nebulosus*	355	0.0	233	<0.1
Sacramento Pikeminnow	*Ptychochelius grandis*	235	0.0	0	0.0
Pacific Lamprey	*Entosphenus tridentatus*	116	<0.1	1,032	<0.1
Starry flounder	*Platichthys stellatus*	80	0.0	4	<0.1
Green Sunfish	*Lepomis cyanellus*	61	<0.1	0	0.0
Delta Smelt	*Hypomesus transpacificus*	36	0.0	4	<0.1
Pond Loach	*Misgurnus anguillicaudatus*	20	<0.1	0	0.0

Appendix A (continued).

		2023		2022	
Common Name	**Scientific Name**	**TFCF Salvage**	**TFCF Percent**	**TFCF Salvage**	**TFCF Percent**
Longfin Smelt	*Spirinchus thaleichthys*	20	0.0	2,954	0.2
Large-scale Loach	*Paramisgurnus dabryanus*	16	<0.1	0	0.0
Sacramento Blackfish	*Orthodon microlepidotus*	16	<0.1	0	0.0
Fathead Minnow	*Pimephales promelas*	8	<0.1	0	0.0
Loach (all spp.)	*Cobitoidea*	8	<0.1	0	0.0
River Lamprey	*Lampetra ayresi*	8	<0.1	0	0.0
Shokihaze Goby	*Tridentiger barbatus*	8	<0.1	0	0.0
Wakasagi	*Hypomesus nipponensis*	8	<0.1	60	<0.1
Blue Catfish	*Ictalurus furcatus*	5	<0.1	0	0.0
Pacific Staghorn Sculpin	*Leptocottus armatus*	4	<0.1	0	0.0
White Crappie	*Pomoxis annularis*	4	<0.1	0	0.0
Hitch	*Lavinia exilicauda*	1	<0.1	0	0.0
Green Sturgeon	*Acipenser medirostris*	0	0.0	0	0.0