Fish Salvage at the Tracy Fish Collection Facility during the 2011 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 2011 water year (10/1/2010-9/30/2011) 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

The daily volume of water exported was reported from gauge readings at the C.W. "Bill" Jones Pumping Plant at Byron. Monthly water exports were plotted and examined for time trends. Annual exports for the Central Valley Project (CVP) from 1981 through 2011 were noted. Salvage data from 1981 to 2011 were examined for analytical convenience and for their relevance to recent conditions.

Fish abundance was reported as "estimated salvage". Only fish longer than 20 mm FL were numerated (counts), because salvage efficiency degrades rapidly for fish smaller than that size. Salvage estimates were primarily obtained by expanding routine sample counts by the duration that water was pumped:

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

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 year. Intra-annual abundances were examined by plotting the monthly salvage totals for selected fish species and for all fish taxa combined for 2011.

The annual and monthly salvage estimates for Chinook salmon and steelhead were made for wild and for hatchery fish. Salmonid origin was determined by the presence (assumed to be wild) or absence (assumed to be hatchery) of an adipose fin. The race of Chinook salmon was classified by the Delta salmon length-race key using body length and date of capture information.

Chinook salmon loss estimates are presented because its loss model has been widely accepted and has undergone extensive field validation. 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 and post-larval (<20 mm FL) fish sampling was done to monitor larval delta smelt and longfin smelt occurrence. 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 sampling ran from March 17 through June 17. Larval fish were identified to species by TFCF personnel and reported the next working day.

Water Exports

The CVP exported 2,539,025 acre feet (AF) of water (Figure 1). The annual export in 2011 was an increase from exports in 2008-2010 which ranged from 1,861,746 to 2,105,748 AF, and was comparable to exports in recent years from 2002 to 2007.

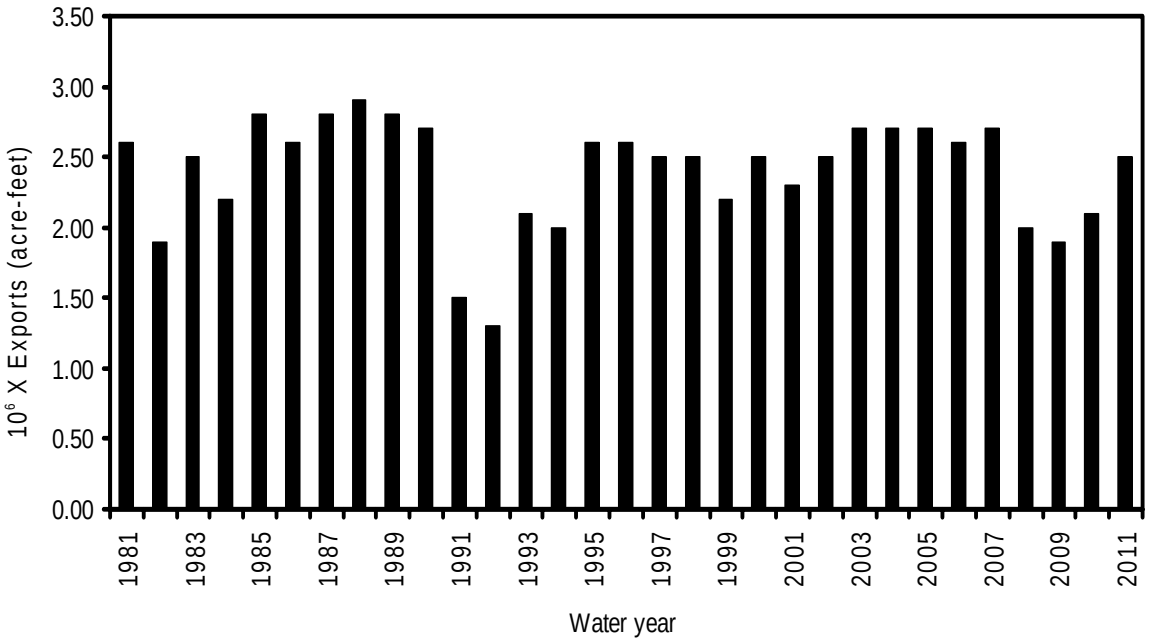

Figure 1 Annual exports (in millions of acre-feet) for the Central Valley Project, 1981 – 2011

The majority of water exports occurred in October-January and July-September (Figure 2). During this period, a total of 1,747,925 AF was exported, accounting for 68.8% of the annual export. Monthly exports ranged from 102,072 to 256,824 AF. Combined export for April-June was 439,633 AF which was comparable to the same period during 2004-2007 (358,873-439,833 AF), but an increase from 2008-2010 (174,096-308,900 AF).

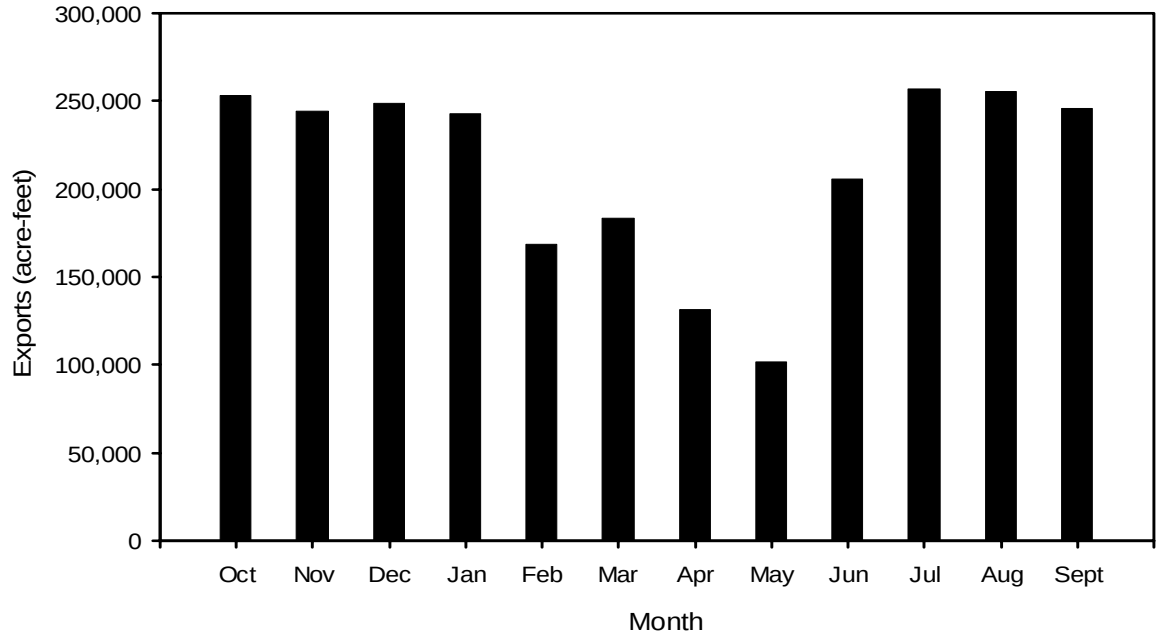

Figure 2 Monthly exports (in acre-feet) for the Central Valley Project, 2011

Total Salvage and Prevalent Species

Salvage at the TFCF was high at 8,724,498 (Figure 3). Salvage in 2011 was an

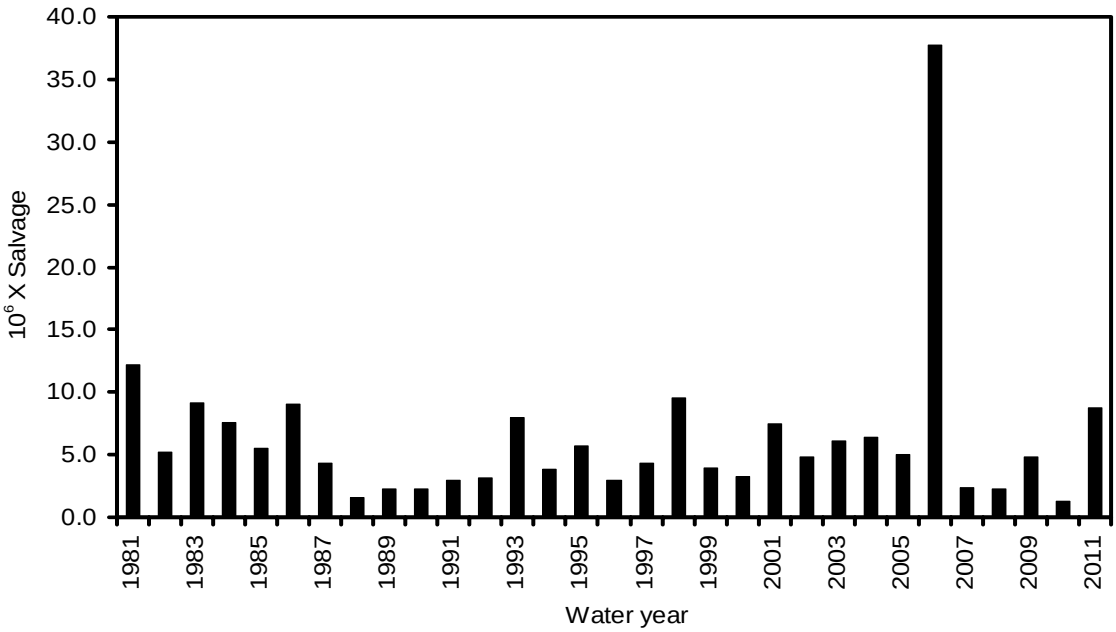

Figure 3 Annual salvage (in millions) of all fish taxa combined at the TFCF, 1981 – 2011

increase from the record-low in 2010 (1,318,613), but well below the record high salvage of 37,659,835 in 2006. Splittail accounted for 87.8% of the annual salvage (Figure 4 and Appendix A). Threadfin shad usually make up the bulk of salvage, but an exception was when common carp accounted for 81.8% (30,495,481) of salvage in 2006. The only other species to be salvaged in substantial numbers were threadfin shad (6.8%) and American shad (1.1%). Striped bass salvage decreased to 0.5% in 2011 compared to 2010 (6.7%) and 2009 (2.7%). Chinook salmon, steelhead, delta smelt, and longfin smelt accounted for 0.3% of salvage.

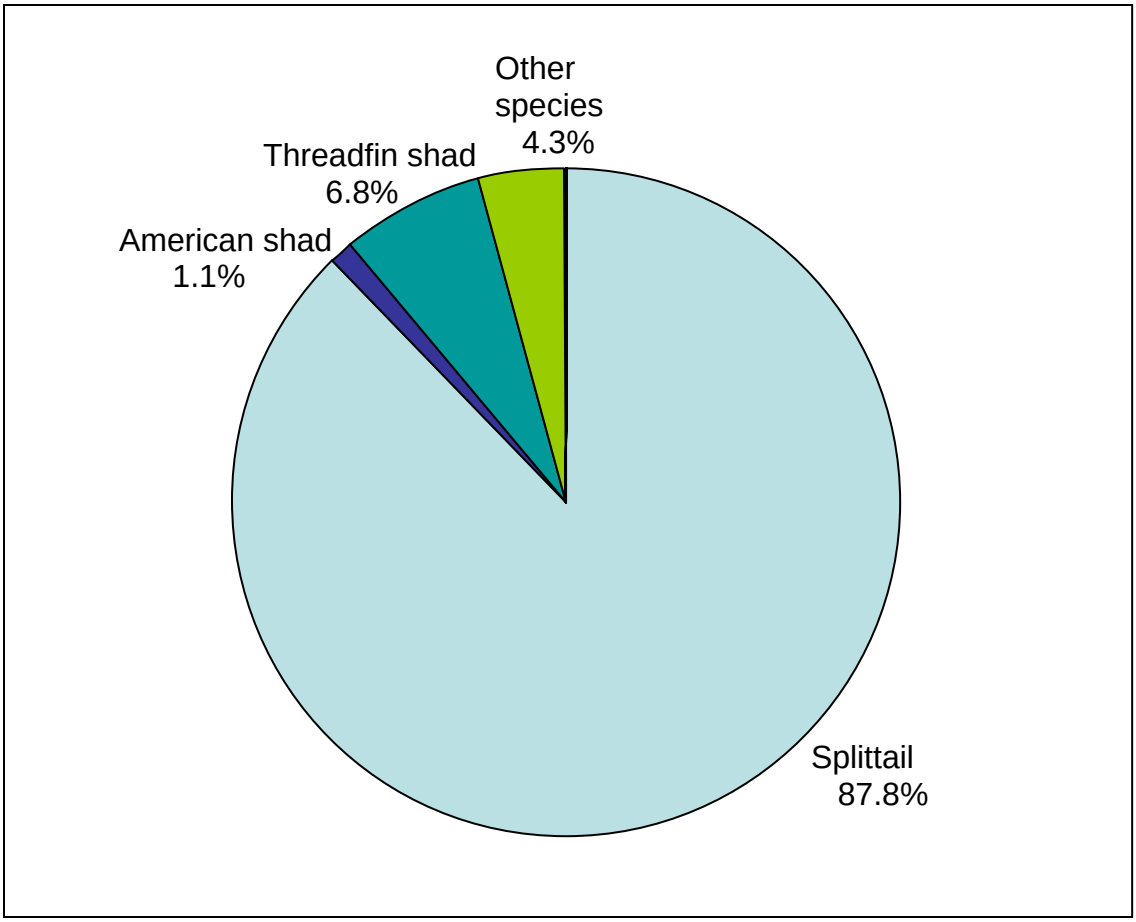

Figure 4 Percentages of annual salvage for the 3 most prevalent species and other species combined at the TFCF, 2011

Chinook Salmon

Annual salvage (all races and origins combined) of 18,135 Chinook salmon continued the low salvage trend since 2001 (Figure 5). Annual salvage was higher than the annual salvage observed in 2007-2010 which ranged from 4,668 to 8,841, but was a substantial decrease from the annual salvage in 2006 (35,331). Mean 2001-2011 salvage was about 7-fold lower than salvage in the 1980's and the late 1990's.

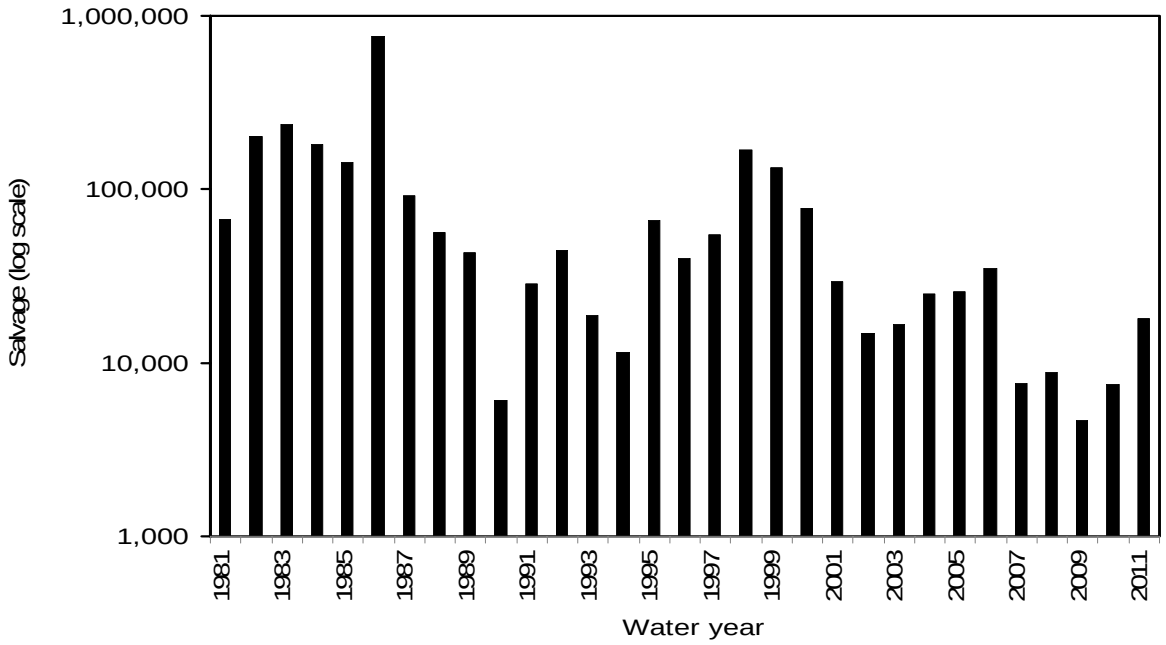

Figure 5 Annual salvage of Chinook salmon (all races and origins combined) at the TFCF, 1981 – 2011

Wild Chinook salmon consisted primarily of fall run salmon (48.8%; Table 1) followed by spring run salmon (45.3%). Wild fall run salmon were salvaged most of the water year except September and October. Wild spring run salmon were salvaged January and March-June (Figure 6). The majority of wild spring run salmon (77%) were salvaged in May and wild fall run salmon (74%) were salvaged in June. The estimated loss of salmon was 13,546 (Table 1).

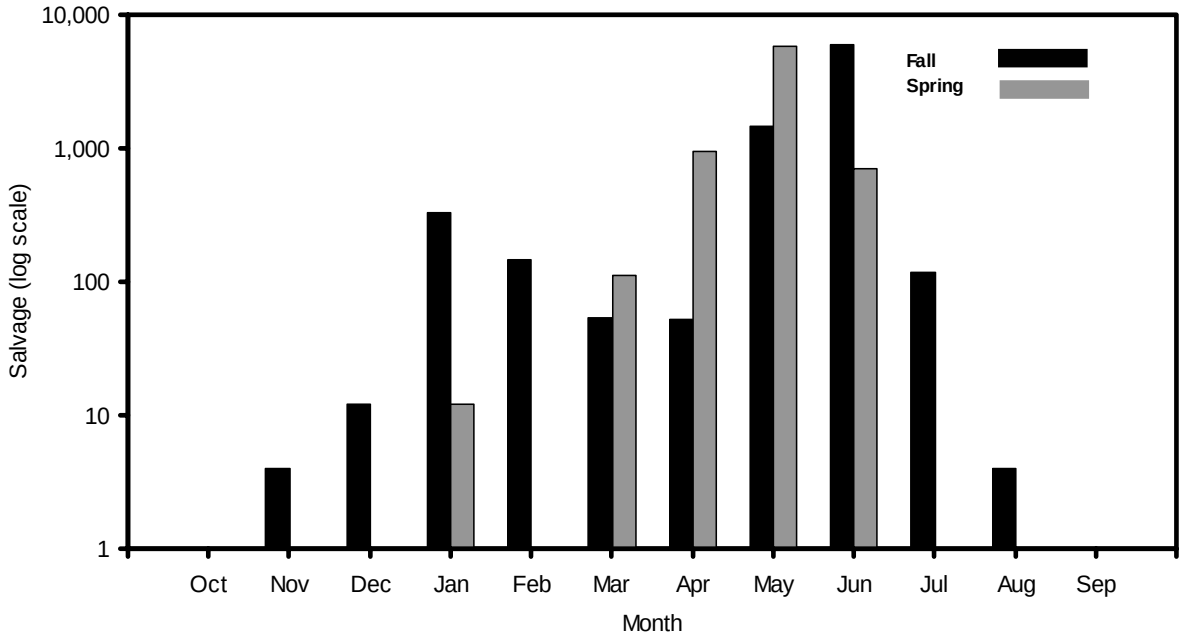

Figure 6 Monthly salvage of wild fall run and wild spring run Chinook salmon at the TFCF, 2011

Table 1 Chinook salmon annual salvage, percentage of annual salvage, race and origin (wild or hatchery), and loss at the TFCF, 2011

Origin	Race	Salvage	Percentage	Loss
Wild	Fall	8,238	48.8	5,906
	Late-fall	160	0.9	105
	Spring	7,636	45.3	6,051
	Winter	842	5.0	577
Total Wild		**16,876**		**12,639**
Hatchery				
	Fall	736	59.0	532
	Late-fall	224	18.0	154
	Spring	136	10.9	111
	Winter	151	12.1	102
Total Hatchery		**1,247**		**899**
Unknown Race		*12*		*8*
Grand Total		***18,135***		***13,546***

Steelhead

Annual salvage (wild and hatchery) of steelhead (445) was the lowest salvage recorded since 1985 (Figure 7). Salvage decreased from 2008-2010 which ranged from 713 to 3,088. Annual steelhead salvage in 2007 (4,068) was greater than in 2005 (1,359) and 2006 (2,516).

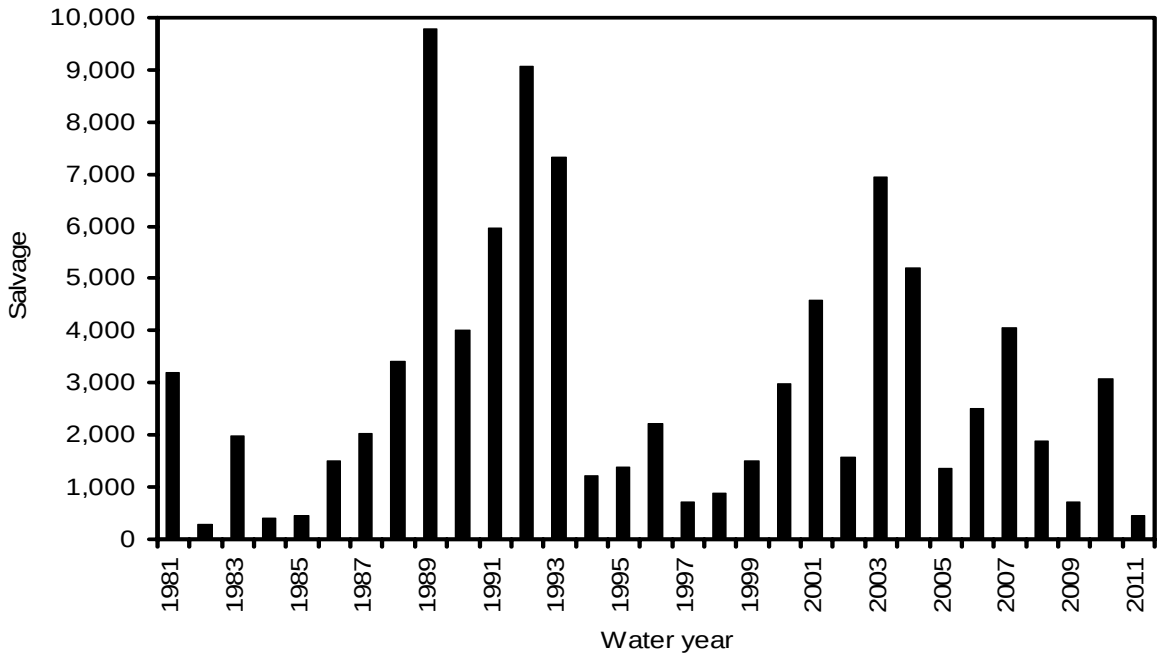

Figure 7 Annual salvage of steelhead (all origins combined) at the TFCF, 1981 – 2011

The majority of salvaged steelhead were of hatchery origin. The salvage composition was 274 hatchery and 171 wild fish.

Salvage of steelhead occurred in the first half of the calendar year and September. Hatchery steelhead were salvaged January-March and May-June while wild steelhead were salvaged February-June and September (Figure 8). Hatchery steelhead were salvaged most frequently in February while wild steelhead were salvaged most frequently in March.

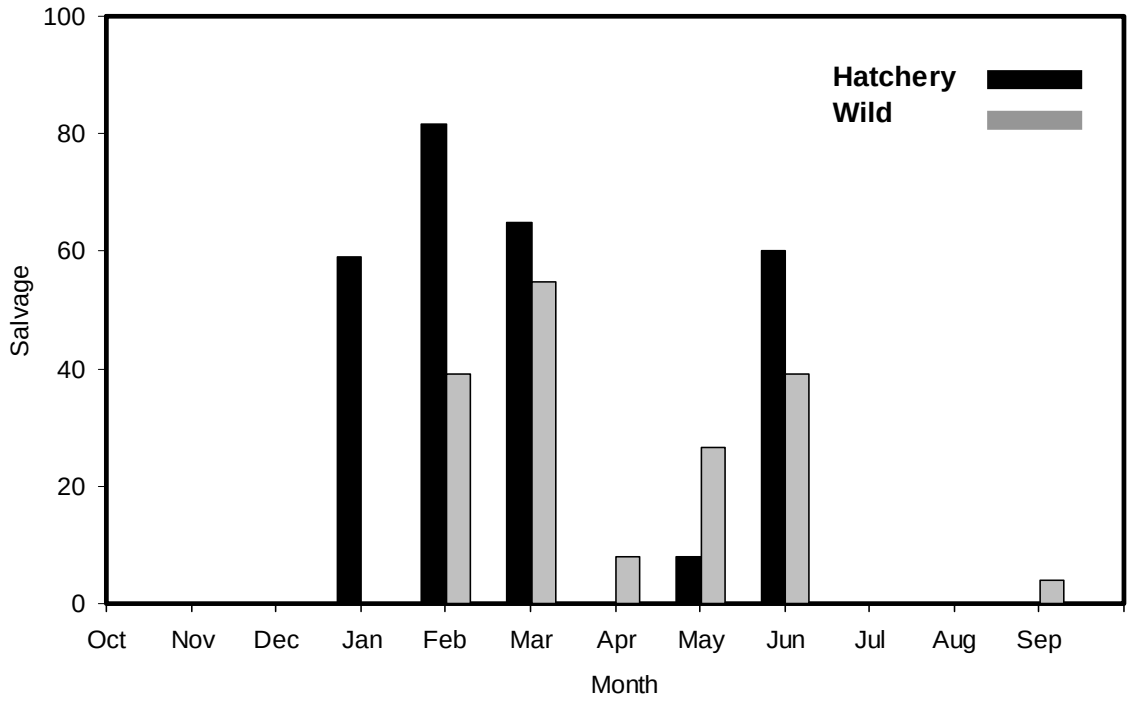

Figure 8 Monthly salvage of hatchery and wild steelhead at the TFCF, 2011

Striped Bass

The record low annual salvage of 39,583 striped bass continued the low trend observed since 1995 (Figure 9). Annual salvage in 2001 (1,204,519) was a large increase from the 1995-2000 salvage but decreased again from 2002-2008 salvage. Prior to 1995 and except for 1983 and 1988, annual striped bass salvage was generally above 1,000,000.

Striped bass exhibited a bimodal monthly salvage distribution and were most frequently salvaged in December-January and July-August (Figure 10). Low salvage in April and May coincided with low monthly water exports. The January salvage (5,010) and July salvage (14,575) accounted for 49.5% of the annual salvage. Striped bass were salvaged every month and the lowest salvage occurred in May (37).

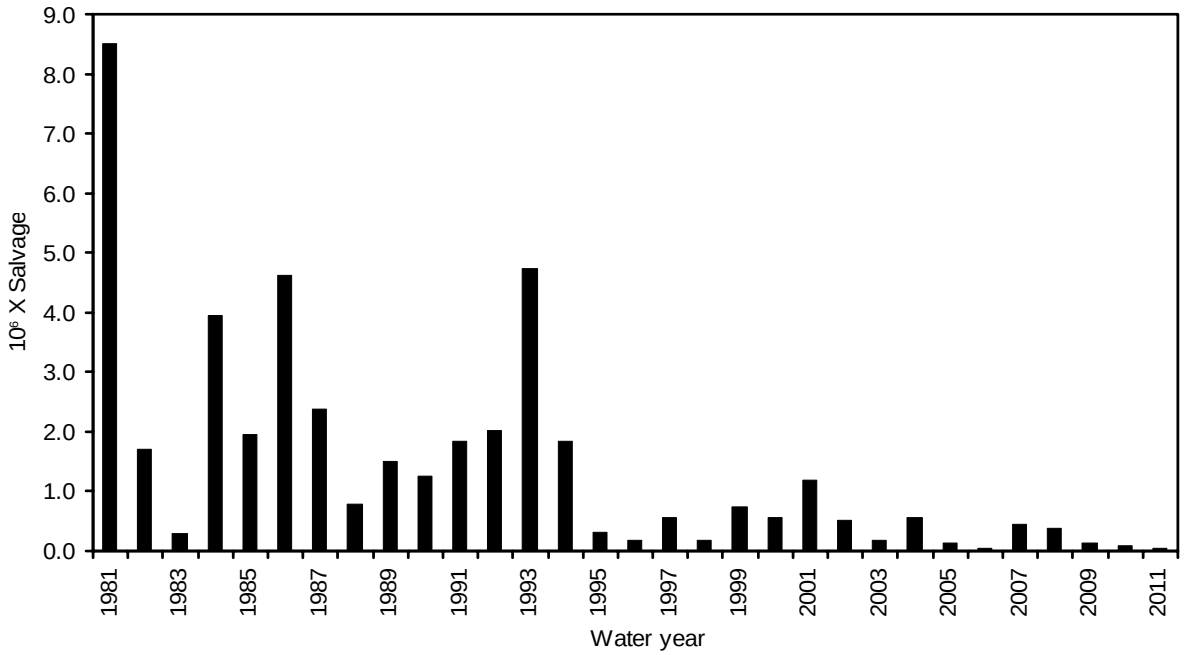

Figure 9 Annual salvage (in millions) of striped bass at the TFCF, 1981 – 2011

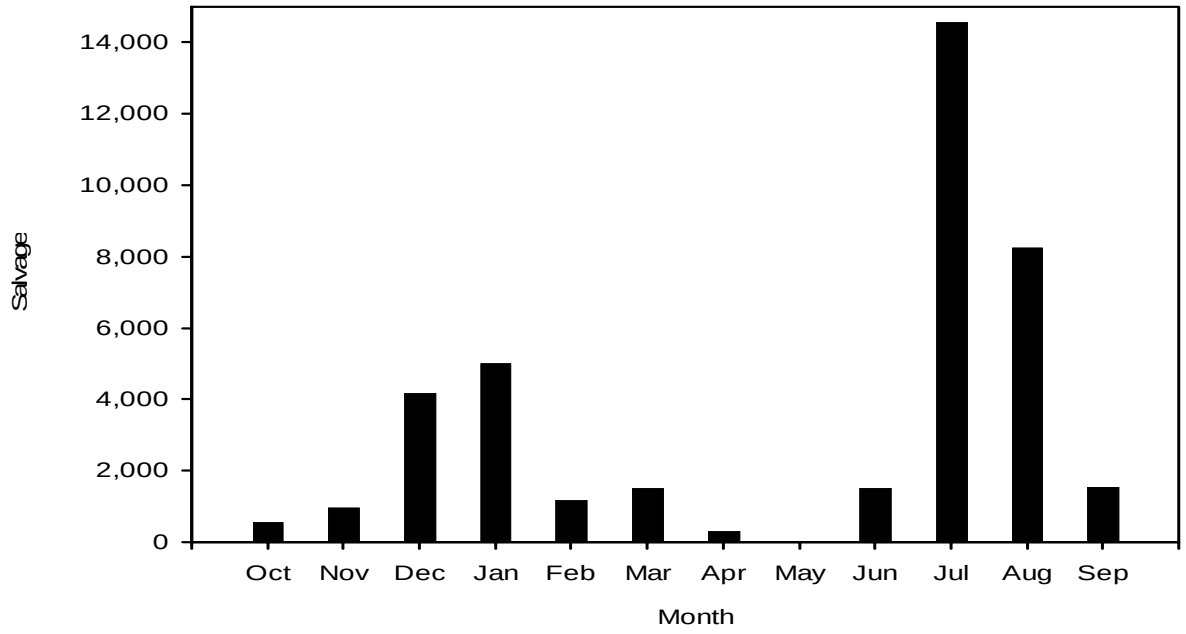

Figure 10 Monthly salvage of striped bass at the TFCF, 2011

Delta Smelt

The annual salvage of delta smelt (51) was the lowest on record and continued the low trend observed since 2005 (Figure 11). Salvage during 2005 to 2011 (51-1,009) was the lowest 7-year period of salvage on record.

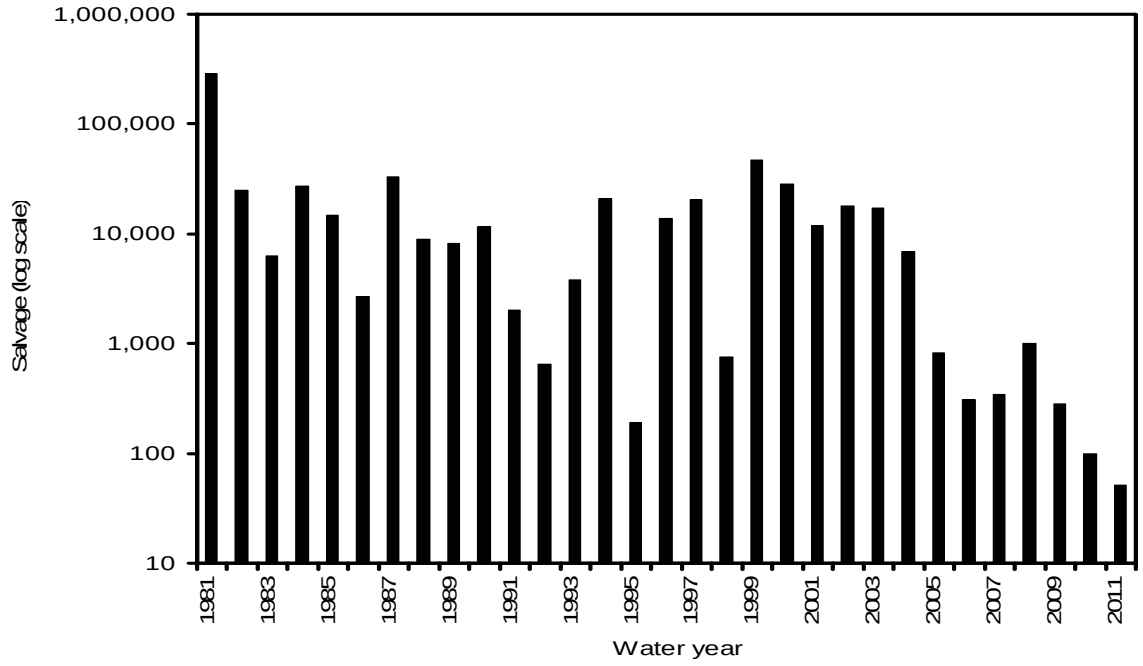

Figure 11 Annual salvage of delta smelt at the TFCF, 1981 – 2011

Adult delta smelt were salvaged most frequently during late winter (Figure 12). Most of the delta smelt were salvaged in March (36) which accounted for 70.6% of the annual salvage. No juvenile delta smelt were salvaged. No delta smelt less than 20 mm were detected at the TFCF.

Longfin Smelt

Longfin smelt continued to be salvaged (4) at low levels. Low annual salvages have

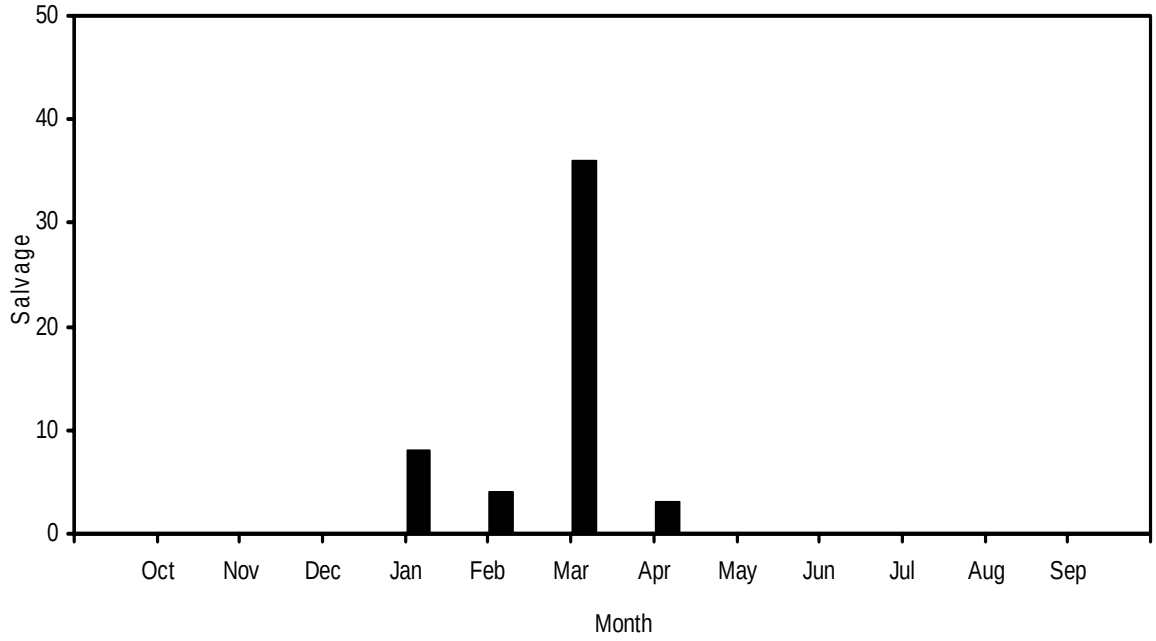

Figure 12 Monthly salvage of delta smelt at the TFCF, 2011

been observed since 1991, with the exception of 43,056 salvaged in 2002 (Figure 13). The annual salvage in 2010 was 31.

Only 4 adult longfin smelt were salvaged in January. No juvenile longfin smelt were salvaged. No longfin smelt less than 20 mm were detected at the TFCF.

Splittail

The record high salvage of splittail (7,660,024) was markedly higher than in 2010 (160,929) and 2009 (1,417). Salvage in 2007 (780) was the lowest in recent record. Splittail salvage has followed a boom-or-bust pattern, often varying year to year by several orders of magnitude (Figure 14).

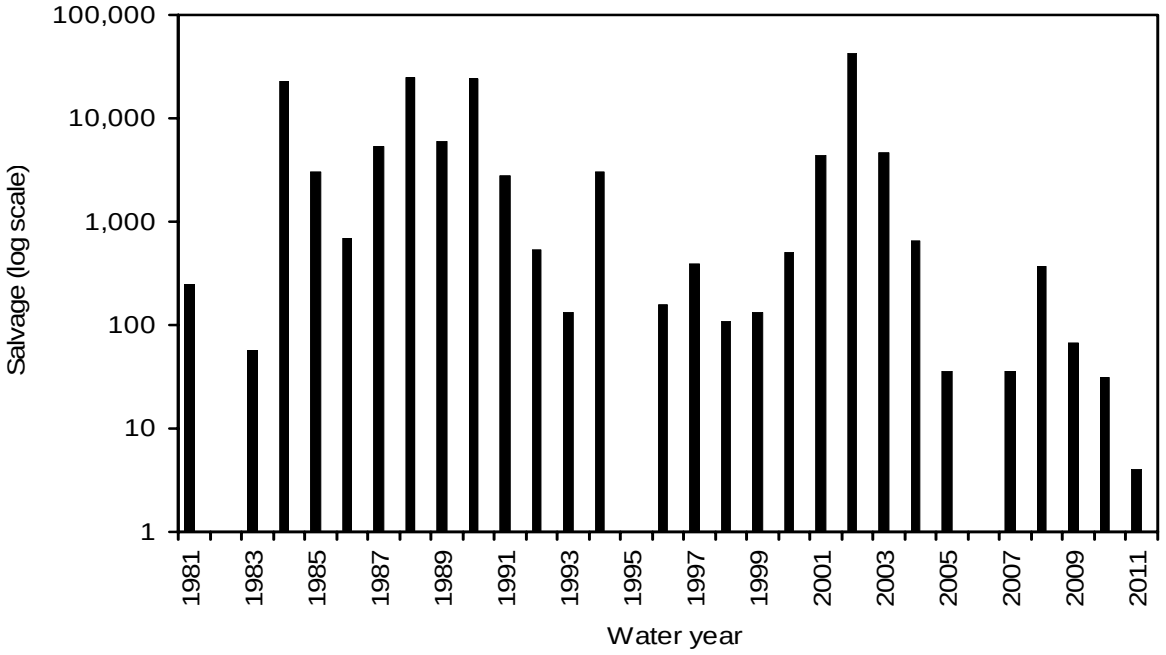

Figure 13 Annual salvage of longfin smelt at the TFCF, 1981 – 2011

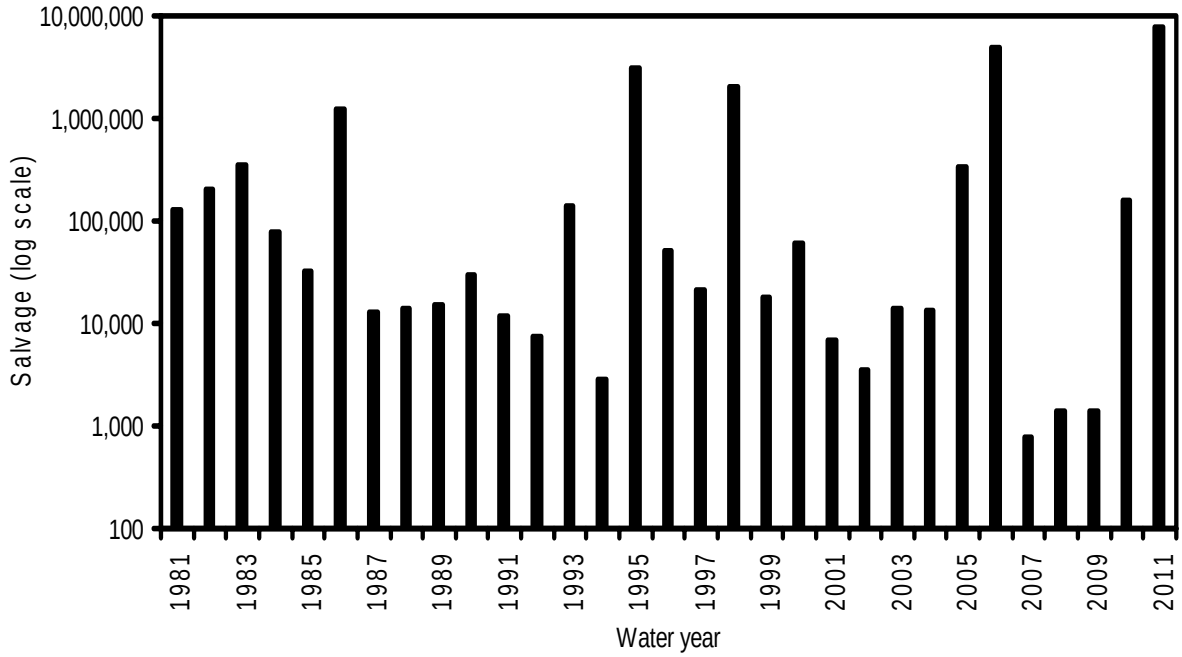

Figure 14 Annual salvage of splittail at the TFCF, 1981 – 2011

Threadfin Shad

Salvage of threadfin shad (591,111) was a decrease from 2010 (763,105), and markedly lower than in 2009 (4,364,853). Similar to splittail, annual salvage of threadfin shad has varied greatly through time (Figure 15). Prior to 2005, the 2001-2004 salvage (3.6-5.2 million) was the highest 4-year period of salvage on record.

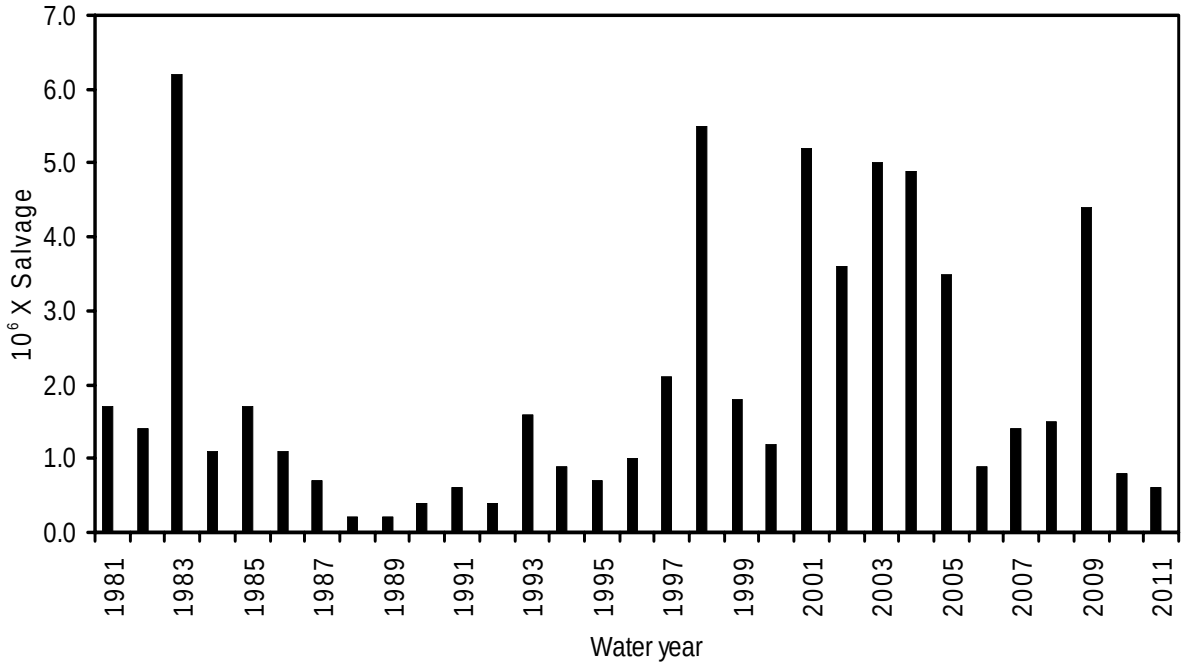

Figure 15 Annual salvage (in millions) of threadfin shad at the TFCF, 1981 – 2011

FOOTNOTES

1. Pelagic Organism Decline (POD) species

Appendix A Annual salvage (salvage) and percentage of annual salvage (%) for fish collected from the TFCF in 2010 and 2011

Species	2011 Salvage	% Composition	2010 Salvage	% Composition
Splittail	7,660,024	87.8	160,929	12.2
Threadfin shad	591,111	6.8	763,105	57.9
American shad	100,233	1.1	112,298	8.5
Bluegill	86,932	1.0	29,538	2.2
White catfish	74,913	0.9	65,160	4.9
Channel catfish	40,288	0.5	33,402	2.5
Striped bass	39,583	0.5	88,286	6.7
Largemouth bass	29,096	0.3	14,459	1.1
Sacramento sucker	27,362	0.3	20	<0.1
Yellowfin goby	22,081	0.3	14,618	1.1
Chinook salmon	18,135	0.2	7,463	0.6
Common carp	8,841	0.1	75	<0.1
Inland silverside	8,359	<0.1	10,445	0.8
Golden shiner	3,200	<0.1	1,145	<0.1
Unknown lamprey	2,651	<0.1	1,461	0.1
Shimofuri goby	2,080	<0.1	6,518	0.5
Rainwater killifish	1,921	<0.1	1,141	<0.1
Black crappie	1,909	<0.1	525	<0.1
Prickly sculpin	1,680	<0.1	3,188	0.2
Redear sunfish	1,454	<0.1	558	<0.1
Warmouth	796	<0.1	168	<0.1
Steelhead	445	<0.1	3,088	0.2
Western mosquitofish	408	<0.1	124	<0.1
White sturgeon	133	<0.1	0	0.0
Brown bullhead	132	<0.1	114	<0.1
Threespine stickleback	123	<0.1	370	<0.1
Fathead minnow	108	<0.1	24	<0.1
Bigscale logperch	104	<0.1	88	<0.1
Tule perch	102	<0.1	36	<0.1
Black bullhead	57	<0.1	45	<0.1
Delta smelt	51	<0.1	99	<0.1
Goldfish	40	<0.1	4	<0.1
Pacific brook lamprey	28	<0.1	0	0.0
White crappie	24	<0.1	0	0.0
Sacramento pikeminnow	12	<0.1	4	<0.1
Sacramento blackfish	12	<0.1	4	<0.1
Green sturgeon	12	<0.1	0	0.0
Pacific staghorn sculpin	12	<0.1	20	<0.1
Red shiner	12	<0.1	11	<0.1

Appendix A (Cont) Annual salvage (salvage) and percentage of annual salvage (%) for fish collected from the TFCF in 2010 and 2011

Species	2011 salvage	% Composition	2010 salvage	% Composition
Starry flounder	11	<0.1	16	<0.1
Green sunfish	9	<0.1	4	<0.1
Blue catfish	8	<0.1	0	0.0
Hitch	4	<0.1	5	<0.1
Longfin smelt	4	<0.1	31	<0.1
Shokihaze goby	0	0.0	12	<0.1
Smallmouth bass	0	0.0	4	<0.1
Wakasagi	0	0.0	8	<0.1