■ Interagency Ecological Program for the San Francisco Estuary ■

IEP NEWSLETTER

VOLUME 22, NUMBER 2, SPRING 2009

■

Stevens, D. E. 1966. Distribution and food habits of the American shad, *Alosa sapidissima*, in the Sacramento-San Joaquin Estuary. Pages 37-107. *In*: Ecological studies of the Sacramento-San Joaquin Delta, Part II, J. L. Turner and D. W. Kelley, compilers. California Department of Fish and Game Fish Bulletin 136.

Stevens, D. E. 1977. Striped bass (*Morone saxatilis*) monitoring techniques in the Sacramento-San Joaquin Estuary. Pages 91-109. *In*: Proceedings of the conference on assessing the effects of power-plant-induced mortality on fish populations. W. Van Winkle, editor. Pergamon Press, New York, New York.

Stevens, D. E., D. W. Kohlhorst, L. W. Miller, and D. W. Kelley. 1985. The decline of striped bass in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 114:12-30.

Stevens, D. E. and L. W. Miller. 1983. Effects of river flow on abundance of young Chinook salmon, American shad, longfin smelt, and delta smelt in the Sacramento-San Joaquin River System. North American Journal of Fisheries Management 3(4):425-437.

Turner, J. L. and H. K. Chadwick. 1972. Distribution and abundance of young-of-the-year striped bass, *Morone saxatilis*, in relation to river flow in the Sacramento-San Joaquin Estuary. Transactions of the American Fisheries Society 101(3):442-52.

Vrooman, A. M., P. A. Paloma, and J. R. Zweiffel. 1981. Electrophoretic, morphometric, and meristic studies of subpopulations of northern anchovy, *Engraulis mordax*. California Fish and Game 67(1):39-51.

Wang, J. C. S. 1986. Fishes of the Sacramento-San Joaquin Estuary and adjacent waters, California: A guide to the early life histories. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary Technical Report 9.

Warzybok, P.M. and R.W. Bradley. 2008. Status of seabirds on southeast Farallon Island during the 2008 breeding season. PRBO Conservation Science, Petaluma, CA. Contribution Number 1668, 10 pp.

Notes

2008 Dayflow data from: iep.water.ca.gov/dayflow/index.html

Marty Gingras, California Department of Fish and Game, email June 29, 2009.

Jaime Janhcke, PRBO Conservation Science, email June 6, 2009.

Fish Salvage at the State Water Project's and Central Valley Project's Fish Facilities during 2008

Geir Aasen(CDFG), gaasen@dfg.ca.gov

Introduction

Two facilities reduce the fish entrainment associated with water export by the federal Central Valley Project (CVP) and California's State Water Project (SWP). The CVP's Tracy Fish Collection Facility (TFCF) and the SWP's Skinner Delta Fish Protective Facility (SDFPF) divert (salvage) fish from water exported from the southern end of the Sacramento-San Joaquin Delta. Both facilities use louver-bypass systems to salvage fish from the exported water. The salvaged fish are periodically loaded into tanker trucks, transported to fixed release sites, and returned to the western Delta. The TFCF began operations in 1957. Operations at the SDFPF began in 1967.

Data from 1982 to 2008 were examined and discussed for analytical convenience and for their relevance to recent conditions. Systematic sampling was used to estimate the numbers and species of fish salvaged at both facilities. Bypass flows into the fish collection buildings were sampled once every 2 hours for 10 to 30 minutes. Fish, 20 mm (fork length: FL) or larger, from the sampled bypass flows were identified and numerated. These fish counts were expanded proportionally based on sample time to estimate the total number of fish salvaged in each 2 hour period of water export. These incremental salvage estimates were then summed across time to derive monthly and annual species-salvage totals for each facility.

Chinook salmon loss estimates are presented because its loss model has been widely accepted and has undergone extensive field validation compared to other species. 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 fish (< 20 mm FL) were also collected and examined to determine the presence of young delta smelt in 2008. Larval sampling began on February 19 at both facilities and ended on June 18 at the SDFPF and on June 15 at TFCF. Larval samples were collected every 6 hours during export operations. The fish screen used in the routine counts was lined with a 0.5 mm

nitex net to retain larval fish. Larval fish were identified to species by TFCF personnel for both facilities.

This report summarizes the 2008 salvage information from the TFCF and the SDFPF. 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 (*Spirinchus thaleichthys*), threadfin shad[1] (*Dorosoma petenense*)[1], and splittail (*Pogonichthys macrolepidotus*).

Water Exports

Water exports were substantially reduced from recent years due to reduced water inflow and legal measures to protect delta smelt. The State Water Project exported roughly 1.5 billion m^3 of water in 2008. Annual SWP exports ranged from 3.0 to 5.0 billion m^3 during 2003 through 2007 (Figure 1). The Central Valley Project exported roughly 2.2 billion m^3 of water in 2008. The annual CVP export in 2008 was also reduced compared to recent years, which ranged from 3.2 to 3.4 billion m^3 annually during 2003 though 2007.

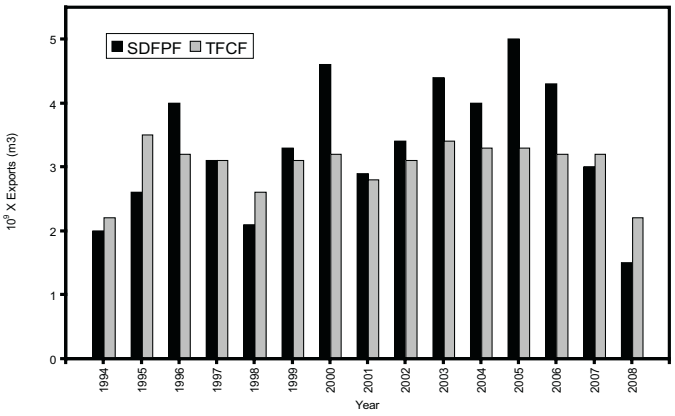

Figure 1 Annual exports in billions of cubic meters for the SWP and the CVP, 1994 to 2008

The monthly water export patterns of the two water projects showed seasonal differences. Water exports peaked during July through November at the CVP and January through February at the SWP (Figure 2). From July through November, 1.3 billion m^3 of water was exported by the CVP representing about 59% of the 2008 annual export. From January through February, 465.0 million m^3 of water were exported by the SWP and represented about 32% of the annual export. The SWP exports during August through October were also reduced compared to recent years. The SWP monthly exports ranged from 39.6 to 242.0 million m^3 of water. The CVP monthly exports ranged from 67.4 to 289.0 million m^3 of water.

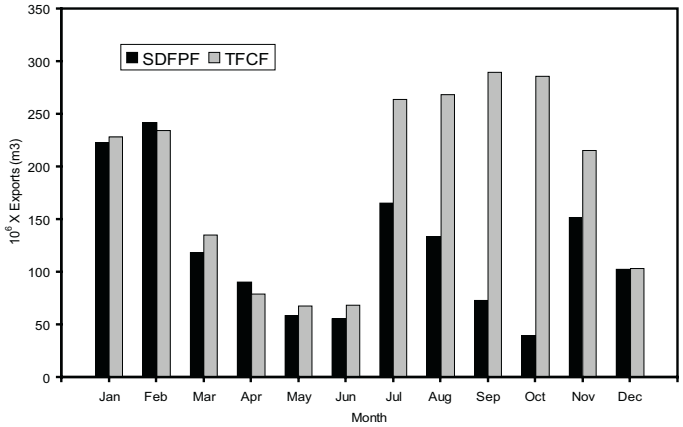

Figure 2 Monthly exports in millions of cubic meters for the SWP and the CVP in 2008

Total Salvage and Prevalent Species

Annual combined salvage (annual salvage) at the SDFPF in 2008 was 648,797 which was the lowest on record (Figure 3). The SDFPF salvage in 2008 decreased substantially in contrast to 2007 and 2006 when 2,239,066 and 5,138,457 fish were salvaged, respectively. Annual salvage at the TFCF in 2008 was 5,365,057. The TFCF annual salvage was slightly greater than that of the previous year (3,164,530) and comparable to annual salvages since 1994 (excluding 2006).

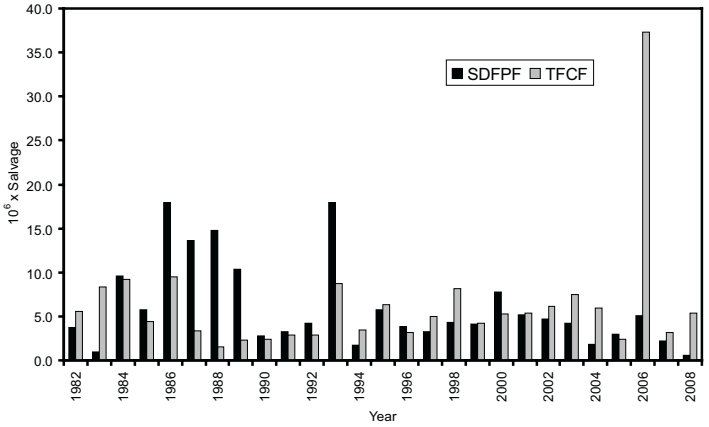

Figure 3 Annual salvage of all taxa combined at the SDFPF and the TFCF, 1982 to 2008

1. Pelagic Organism Decline (POD) species

Threadfin shad were the most salvaged fish species at both facilities. Threadfin shad dominated the annual salvage at the TFCF and accounted for 86.1% of the number of fish salvaged (Figure 4). Striped bass were the only other species to be salvaged in substantial numbers at the TFCF. Threadfin shad accounted for 43.2% of the annual salvage at the SDFPF. Striped bass and American shad also contributed to the annual salvage at the SDFPF. Threadfin shad have generally made up the bulk of salvage at both facilities in recent years. In 2008, relatively few (< 0.4% of total annual salvage) Chinook salmon, steelhead, delta smelt, longfin smelt, and splittail were salvaged at the SDFPF and TFCF.

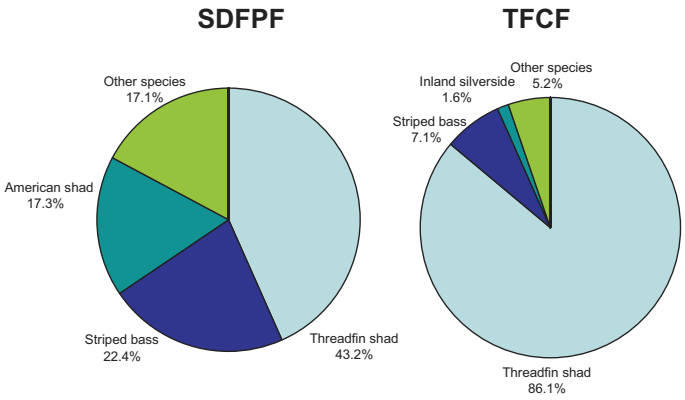

Figure 4 Percentages of annual salvage for the 3 most prevalent species and other species combined at the SDFPF and TFCF, 2008

Chinook Salmon

Annual salvage (all races and origins combined) of Chinook salmon continued to be low at both facilities. The annual salvage of 4,928 at the SDFPF in 2008 continued the declining trend which started in 2001 (Figure 5). The annual salvage of Chinook salmon in 2008 was larger than the annual salvage of 1,941 observed in 2007, but was a decrease from the annual salvage of 8,629 observed in 2006. Mean annual SDFPF salvage from 2001 to 2008 was about 8-fold lower than salvage in the 1980's. The annual salvage of Chinook salmon at the TFCF was 8,786 in 2008. The annual salvage of Chinook salmon in 2008 was similar to the annual salvage of 7,622 observed in 2007, but was a decrease from the annual salvage of 35,319 observed in 2006. Mean annual TFCF salvage from 2001 to 2008 was about 6-fold lower than salvage in the 1980's and the late 1990's.

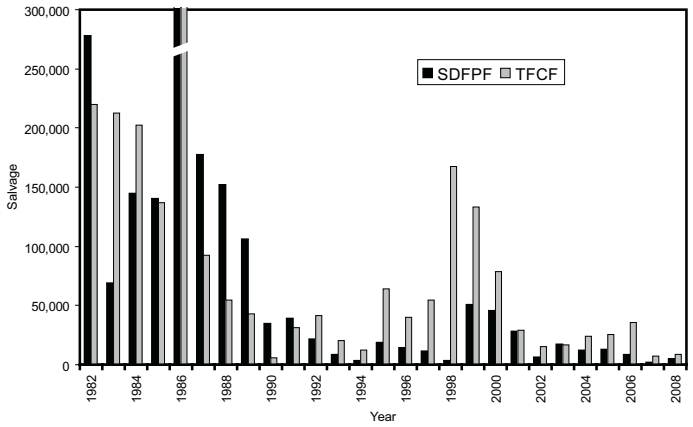

Figure 5 Annual salvage of Chinook salmon (all races and origins combined) at the SDFPF and the TFCF, 1982 to 2008. The SDFPF 1986 salvage of 435,233 and the TFCF 1986 salvage of 752,039 have been truncated for scale considerations

Salvaged Chinook salmon at both facilities were primarily wild spring-run fish and wild fall-run fish (Table 1). Spring-run fish comprised 54% and 44% of the annual salvage of wild Chinook salmon at the SDFPF and the TFCF, respectively. Wild fall-run fish comprised 40% of the annual salvage of wild salmon at the SDFPF and about 49% of the wild salmon salvaged at the TFCF. The majority of wild fall-run fish at the SDFPF and TFCF were salvaged in May (Figure 6).

Loss of Chinook salmon in 2008 was higher at the SDFPF than at the TFCF (Table 1). At the SDFPF the annual loss of salmon was estimated at 21,697 while at the TFCF the estimated annual loss was 7,010. Higher losses within Clifton Court Forebay were the major cause for the greater entrainment losses for the SWP compared to the CVP.

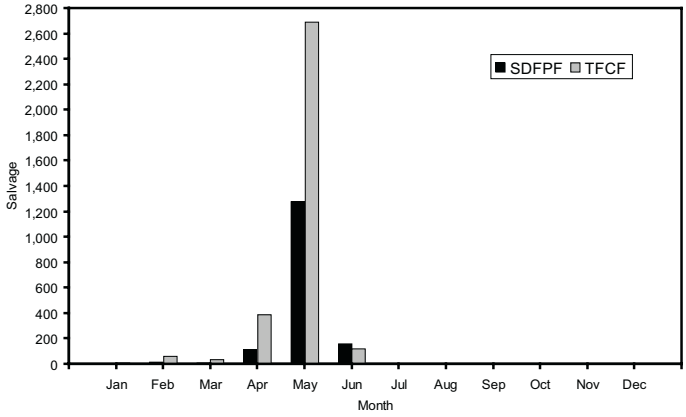

Figure 6 Monthly salvage of wild, fall-run Chinook salmon at the SDFPF and the TFCF, 2008

Table 1 Chinook salmon annual salvage, percentage of annual salvage, race and origin (wild or hatchery), and loss at the SDFPF and the TFCF, 2008

Facility	Origin	Race	Salvage	Percentage	Loss
SDFPF					
	Wild				
		Fall	1560	40	6921
		Late-fall	10	<1	45
		Spring	2142	54	9268
		Winter	207	5	917
	Total Wild		**3919**		**17151**
	Hatchery				
		Fall	0	0	0
		Late-fall	24	3	109
		Spring	48	5	206
		Winter	937	93	4231
	Total Hatchery		**1009**		**4546**
	Grand Total		**4928**		**21697**
TFCF					
	Wild	Fall	3,285	49	2,675
		Late-fall	4	<1	4
		Spring	2,954	44	2,486
		Winter	462	6	383
	Total Wild		**6,705**		**5,548**
	Hatchery				
		Fall	4	<1	3
		Late-fall	56	2	41
		Spring	59	3	45
		Winter	1,954	94	1,368
	Total Hatchery		**2,073**		**1,457**
	Unknown Race		8		5
	Grand Total		**8,786**		**7,010**

Steelhead

The annual salvage of steelhead (all origins combined) at both facilities continued to be low in 2008 and has remained low since 2005 (Figure 7). Annual salvage at the SDFPF in 2008 was higher than in 2007: 1,944 as opposed to 1,561. This pattern was opposite at the TFCF as the annual salvage in 2008 was lower than in 2007: 1,887 as opposed to 4,068.

Hatchery steelhead made up the majority of the fish salvaged at both facilities. At the TFCF, the salvage composition was 1,578 hatchery and 309 wild steelhead. The salvage composition was 1,267 hatchery and 677 wild steelhead at the SDFPF.

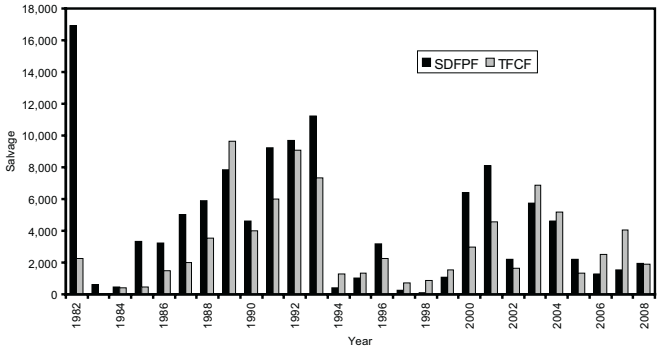

Figure 7 Annual salvage of steelhead (all origins combined) at the SDFPF and the TFCF, 1982 to 2008

The salvage of wild steelhead occurred in the first half of the year at both facilities. Wild steelhead were salvaged from January through July at the SDFPF and from January through May at the TFCF (Figure 8). Wild steelhead were salvaged most frequently during February through May at the SDFPF. At the TFCF, wild steelhead were salvaged most frequently during January through April.

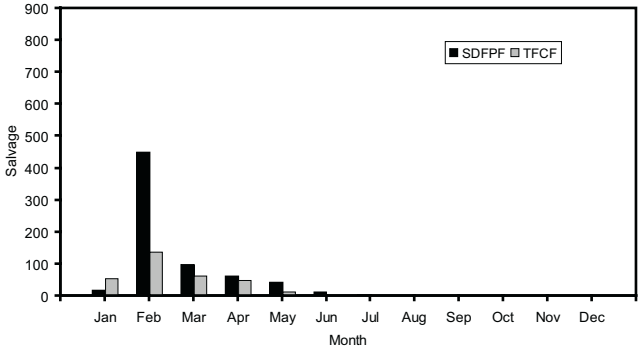

Figure 8 Monthly salvage of wild steelhead at the SDFPF and the TFCF, 2008

Striped Bass

In 2008, both facilities reported relatively low annual salvage of striped bass. At the SDFPF, the 2008 annual salvage was 145,580. The 2008 annual salvage was just slightly more than the minimum for the period of record: 131,039 in 1983. The low 2008 salvage at the SDFPF continued the generally low annual salvage observed since the mid 1990's (Figure 9). The low annual TFCF salvage of 378,916 striped bass in 2008 also continued the trend of low annual salvage since 1995. Prior to 1995, annual striped bass salvage was generally above 1,000,000 except for 1983 and 1988 at the TFCF and 1983 and 1994 at the SDFPF.

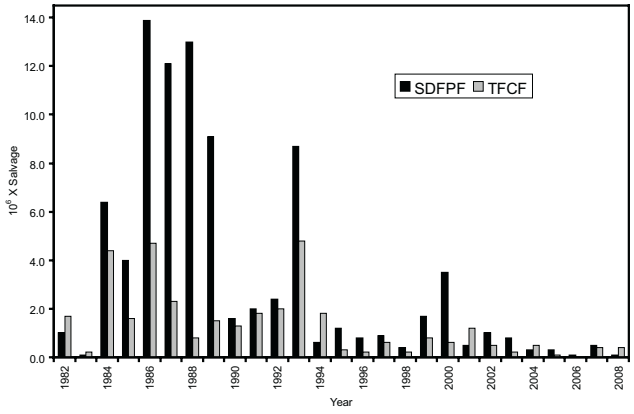

Figure 9 Annual salvage of striped bass at the SDFPF and the TFCF, 1982 to 2008

The months of January and July accounted for the majority of salvaged striped bass at the SDFPF and June and July at the TFCF (Figure 10). At the SDFPF, the January salvage of 50,111 and the July salvage of 49,386 accounted for 68% of the 2008 annual salvage. At the TFCF, the June salvage of 111,035 and the July salvage of 189,497 accounted for 79% of the annual salvage. Striped bass were salvaged every month at both facilities with the lowest monthly salvage occurring in April at both the SDFPF (131) and the TFCF (228).

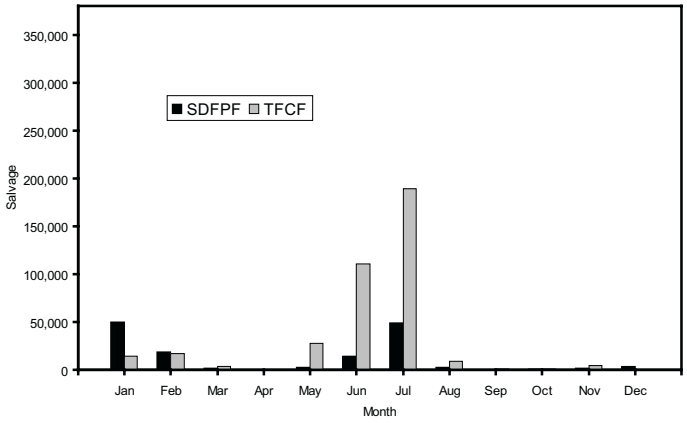

Figure 10 Monthly salvage of striped bass at the SDFPF and the TFCF, 2008

Delta Smelt

Compared to the historical levels, few delta smelt were salvaged in 2008 (Figure 11). The annual salvage at the SDFPF decreased in 2008 to 1,029 compared to 2,360 delta smelt salvaged in 2007. The annual salvage at the TFCF was higher in 2008 (1,009) compared to the near record low of 348 in 2007. The recent annual salvages of delta smelt were the lowest 4-year period of salvage on record for both facilities.

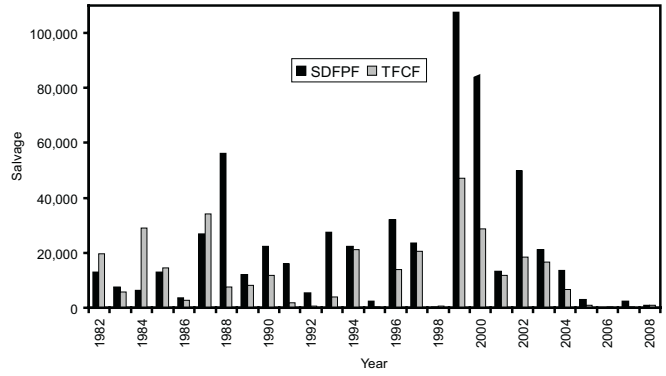

Figure 11 Annual salvage of delta smelt at the SDFPF and the TFCF, 1982 to 2008

Most delta smelt were salvaged in a few months during the first half of 2008 (Figure 12). Juvenile delta smelt were most frequently salvaged in May (416) and June (499) at the SDFPF, which accounted for 89% of the annual salvage. The salvage of delta smelt (primarily juveniles) also peaked in May and June at the TFCF.

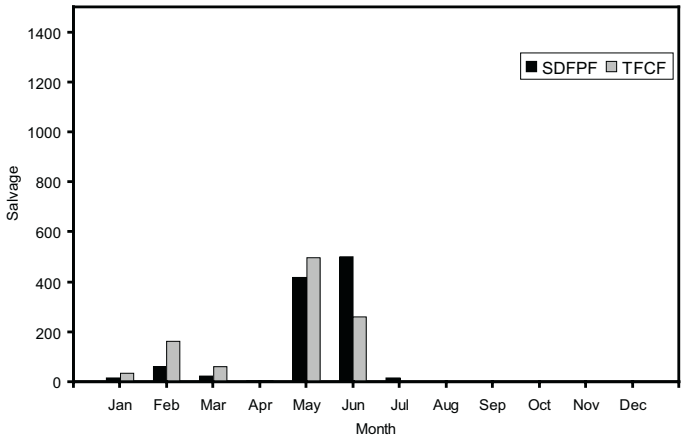

Figure 12 Monthly salvage of delta smelt at the SDFPF and the TFCF, 2008

Delta smelt less than 20 mm were first detected in larval fish samples from the TFCF on April 10 (Table 2). Delta smelt larvae or post-larvae were observed on 10 days of monitoring at the TFCF. The longest period of consecutive daily detections was a 3-day period during May 2-4. Larval delta smelt were most frequently detected in May (5 days). Delta smelt larvae were not observed from the larval fish samples from the SDFPF.

Table 2 Occurrence of delta smelt and longfin smelt larvae among larval fish collected from the TFCF in 2008. A "Y' indicates that larval delta or longfin smelt < 20 mm FL were found while an "N" indicates no detection. Number of counts per day with young smelt were recorded in parenthesis.

	Delta smelt larvae	Longfin smelt larvae
DATE	Y or N	Y or N
3/6/2008	N	Y
4/1/2008	N	Y
4/3/2008	N	Y
4/5/2008	N	Y
4/10/2008	Y	N
4/11/2008	N	Y
4/12/2008	N	Y
4/13/2008	N	Y
4/14/2008	N	Y (2)
4/15/2008	N	Y
4/16/2008	N	Y
4/17/2008	N	Y
4/19/2008	N	Y (2)
4/20/2008	N	Y
4/23/2008	Y	Y
4/24/2008	N	Y
4/28/2008	N	Y
4/30/2008	Y (2)	N
5/2/2008	Y	Y
5/3/2008	Y	N
5/4/2008	Y	N
5/25/2008	Y	N
5/29/2008	Y	N
6/1/2008	Y	N
6/4/2008	Y	N

Longfin Smelt

Longfin smelt continued to be salvaged at a low level compared to the early 2000s and the late 1980s (Figure 13). The annual salvage in 2008 was 1,112 at the SDFPF and 357 at the TFCF. Longfin smelt were salvaged in winter and spring at both facilities (Figure 14). Juvenile longfin smelt were most frequently salvaged in April (146) and May (924) at the SDFPF, which accounted for 96% of the annual salvage. The salvage of longfin smelt also peaked in April and May at the TFCF, and was composed primarily of juvenile fish.

Similar to the delta smelt findings, longfin smelt larvae or post-larvae were more frequently found in the larval fish samples from the TFCF. Young longfin smelt were detected on 17 occasions at the TFCF, mostly in April (Table 2). Only 2 longfin smelt larvae detections were made at the SDFPF on February 24 and 26. Longfin smelt were first detected in the larval fish samples from the TFCF on March 6. The longest period of consecutive daily detections was a 7-day period during April 11-17.

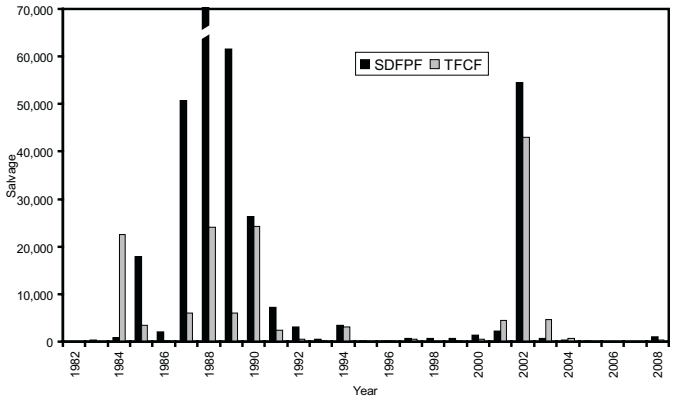

Figure 13 Annual salvage of longfin smelt at the SDFPFand the TFCF, 1982 to 2008. The annual salvage at the SDFPF for 1988 has been truncated for scale considerations (140,040).

F

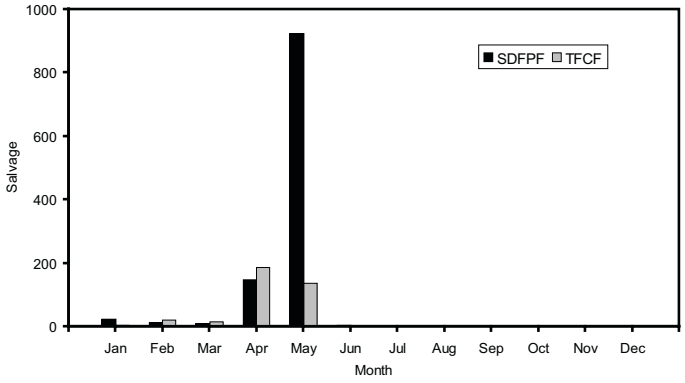

Figure 14 Monthly salvage of longfin smelt at the SDFPF and the TFCF, 2008

Splittail

The annual salvages of splittail were higher for both facilities in 2008 than in 2007, but remained low compared to recent years. The 2008 annual salvage was 4,979 at the SDFPF as opposed to 538 in 2007. The TFCF salvaged 1,439 splittail in 2008 compared to 780 in 2007. The 2007 TFCF salvage was the lowest on record since 1982 and a marked decrease from the record-high salvage of 5.0 million in 2006. Splittail salvages have followed a boom or bust pattern where annual totals often varied several orders of magnitude from year to year (Figure 15).

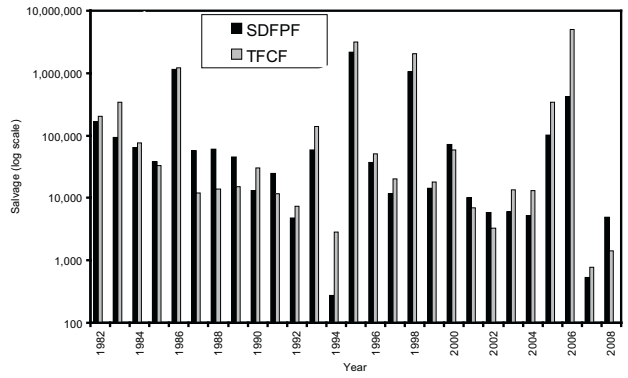

Figure 15 Annual salvage of splittail at the SDFPF and the TFCF, 1982 to 2008

Threadfin Shad

The annual salvages of threadfin shad differed greatly between facilities in 2008. Over 4 million (4,617,313) threadfin shad were salvaged at the TFCF compared to 280,084 salvaged at the SDFPF. The TFCF annual salvage was the fourth largest total and the SDFPF annual salvage was the third lowest total for their respective facilities since 1982.

The 2008 annual salvages also differed markedly from the annual salvages from the previous year (Figure 16). Similar to splittail, annual salvages of threadfin shad have varied greatly through time.

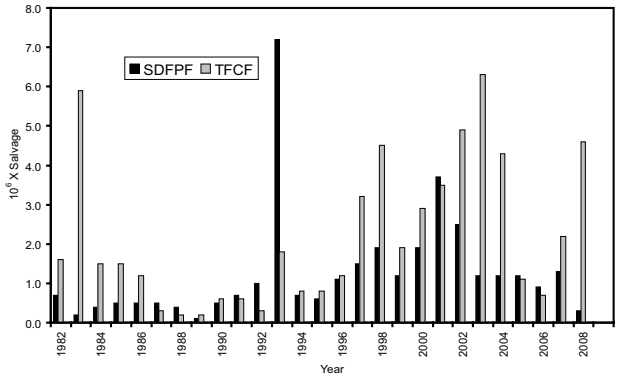

Figure 16 Annual salvage of threadfin shad at the SDFPF and the TFCF, 1982 to 2008