2005 Fish Salvage at the Tracy Fish Collection Facility, Annual Report

by

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Introduction

The Tracy Fish Collection Facility (Federal Facility) diverts (salvages) fish from water exported from the San Francisco Estuary. The Federal Facility began operation in 1957 and uses a louver-bypass system to salvage fish from the exported water. The salvaged fish are returned to the San Francisco Estuary by loading the salvaged fish into tanker trucks and trucking them to predetermined release sites.

This report summarizes 2005 salvage information from the Federal Facility. The following species are given individual consideration: Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), striped bass[1] (*Morone saxatilis*), American shad (*Alosa sapidissima*), longfin smelt (*Spirinchus thaleichthys*), delta smelt[1] (*Hypomesus transpacificus*), inland silversides[1] (*Menidia beryllina*), threadfin shad[1] (*Dorosoma petenense*), Sacramento splittail (*Pogonichthys macrolepidotus*), and Chinese mitten crab (*Eriocheir sinensis*).

Methods

Export and temperature data were gathered and summarized as follows. The daily volume of water exported is reported daily from gauges on the pumps at Byron (Brent Bridges, USBR, Personal Communication, December 2005). Daily exports were summed on a monthly basis. Water temperature is taken every 2 hours during normal operations at the Federal. Daily mean water temperature was calculated and examined for time trends.

1. Pelagic Organism Decline (POD) species.

Abundance of species encountered at the Federal Facility is reported in terms of estimated salvage. Catch at the Federal Facility from routine samples and predator removals are used to calculate salvage. Only fish that are greater than 20 mm FL (TL in the case of sturgeon, *Acipenser spp.*) are counted or measured as the salvage efficiency of the Federal Facility drops off rapidly for fish less than this size. Salvage from normal samples is an expanded catch from the sample (count) for a given time that water is pumped:

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

Routine counts are taken at 2 hour intervals, for 10 minutes, while water is being exported. This is similar to the Skinner Delta Fish Protective Facility which samples at 1 – 2 hour intervals for 5, 10, or 20 minutes, depending upon the number of fish encountered. Fish collected from predator removals are not expanded:

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

The salvage values from Equations 1 and 2 were summed on an annual basis from 1981 to 2005 and monthly for each month in 2005. Annual percentage for a given species was calculated by dividing the annual salvage for a species by the annual salvage of all taxa combined. Monthly density was determined by dividing the combined monthly salvage of all taxa by the monthly exports (ind/acre-feet).

Chinook salmon and steelhead had annual and monthly salvage calculated by wild, hatchery or unknown origin status, and for Chinook salmon, by race. The wild or hatchery status of a salmonid is determined by the presence (wild) or absence (hatchery) of the adipose fin. This

information is recorded when a salmonid is measured. The race of Chinook salmon was determined from the Delta Salmon Length-Race Key. This key provides a length range for each race for each date of the year. Salmonids of unknown origin are salmonid observations without length and adipose fin status information.

Loss for Chinook salmon was calculated annually by race and on a monthly basis for all months in 2005. Loss, the estimated number of fish encountered by the facility minus the fish that survive salvage operations, is reported for salmon only. Where as salvage is simple calculation (see above), loss estimates are dependent on knowing variables such as trucking/handling loss and louver efficiency. The variables are defined for salmon only in regards to the Federal Facility.

Exports

The Central Valley Project (CVP) exported 2,697,077 acre-feet (AF) (3.33 billion m^3) of water in 2005, almost the identical amount exported in 2004 (roughly 2,695,000 AF). Exports decreased from 259,248 AF in January to 65,875 AF in May (Figure 1). Monthly exports from June through December were stable, ranging from 247,959 – 277,049 AF (Figure 1).

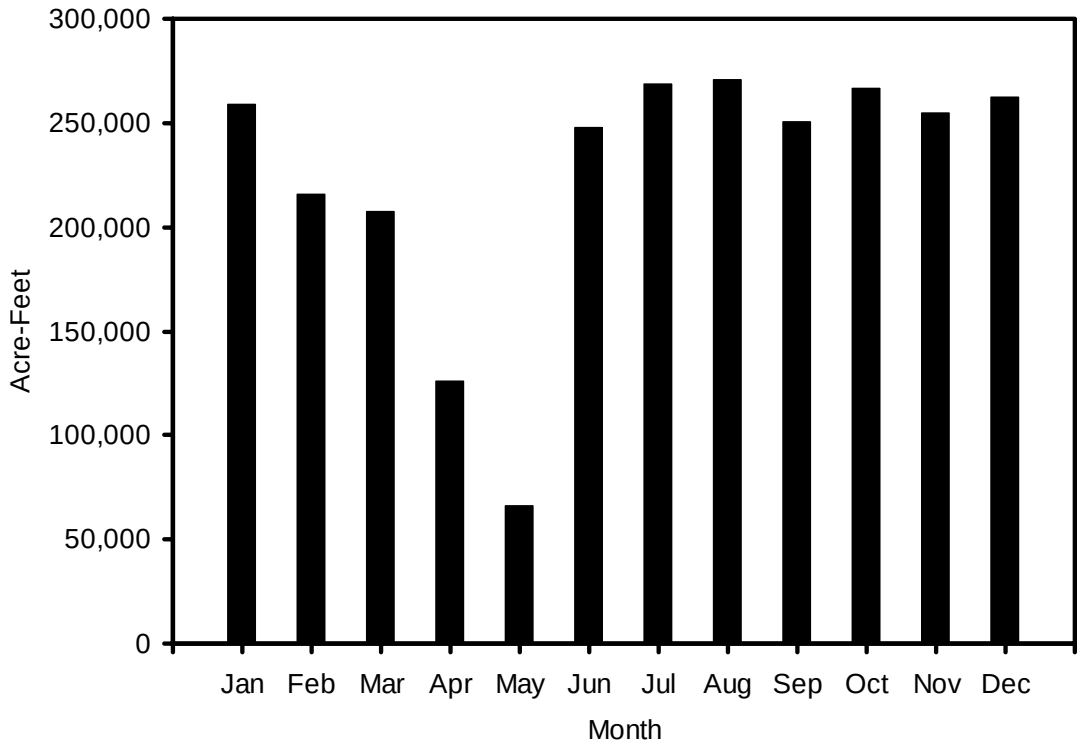

Figure 1. Monthly water exports (acre-feet) for the Central Valley Project, 2005.

Fish Salvage

The 2005 annual salvage at the Federal Facility was less than in 2004 with the bulk of the 2005 salvage being represented by 7 species. The Federal Facility 2005 annual combined salvage (fish and mitten crabs) was 2,429,973 and represented 41% of the annual combined salvage in 2004 (5,867,228). Although the Federal Facility salvaged 43 fish species, 1 fish taxon (unknown lamprey, *Lampetra spp.*) and Chinese mitten crabs, the annual salvage was dominated by: threadfin shad (45.7%), Sacramento splittail (14.1%), American shad (13.5%), bluegill (*Lepomis macrochirus*) (7.5%), white catfish (*Ameiurus catus*) (7.0%), and striped bass (5.1%). The aforementioned species constituted 92.9% of the annual salvage (Appendix Table 1). The percentage of annual salvage represented by threadfin shad in 2005 continued the decline that started in 2003 (Figure 2). Density (individuals salvaged per 10,000 m^3) was highest in the following months: June, September, and November (Figure 3).

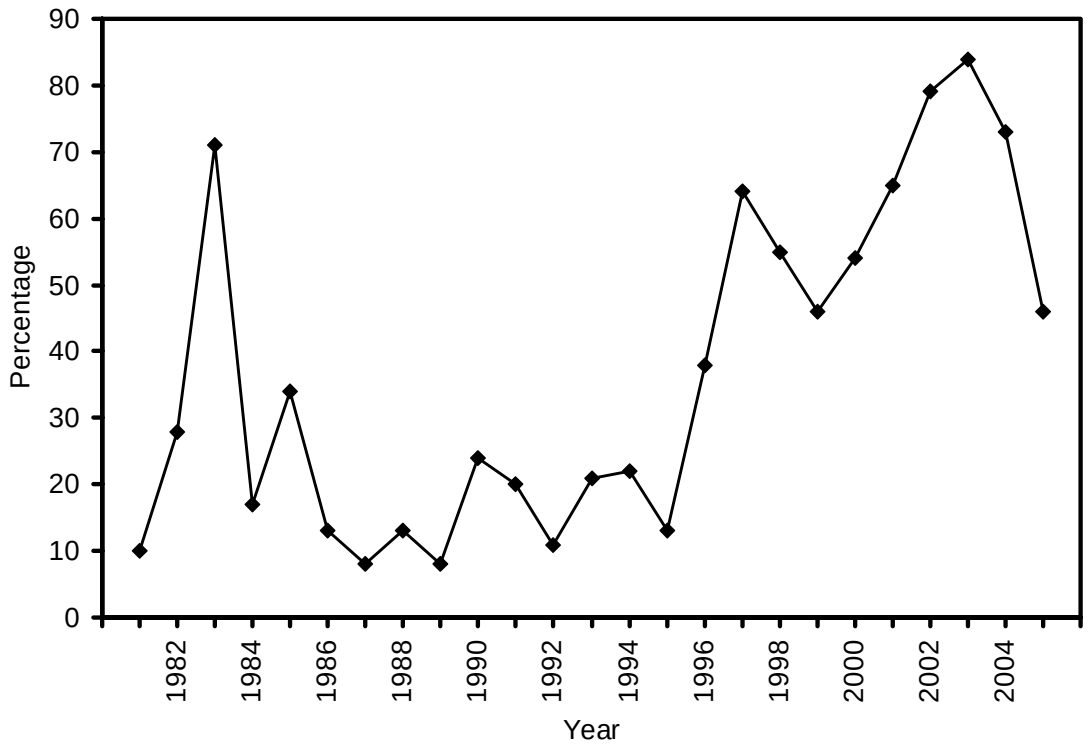

Figure 2. Percentage of annual salvage (percentage) represented by threadfin shad at the Federal Facility, 1981 – 2005.

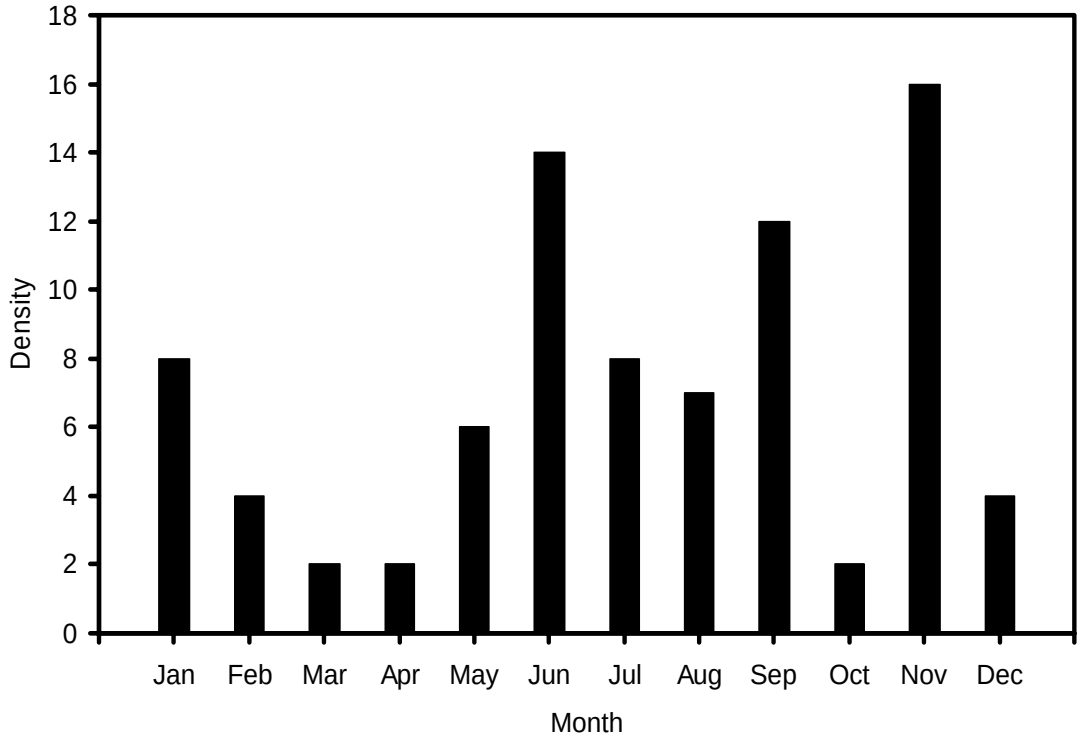

Figure 3. Monthly density (density, ind/10,000 m^3) for all taxa combined at the Federal Facility, 2005.

Delta Smelt

The salvage of delta smelt was very low in 2005, but not the record low. In 2005, 830 delta smelt were salvaged, 12% of the annual salvage in 2004 (6,769). However, the lowest year of record (since 1981) was 180 in 1995. Delta smelt salvage has been in constant decline since 2002 (Figure 4).

Salvage of delta smelt in 2005 occurred in 2 discrete pulses. Salvage occurred in January-February (adults, previous year class) and May-June (juveniles, current year class) (Figure 5).

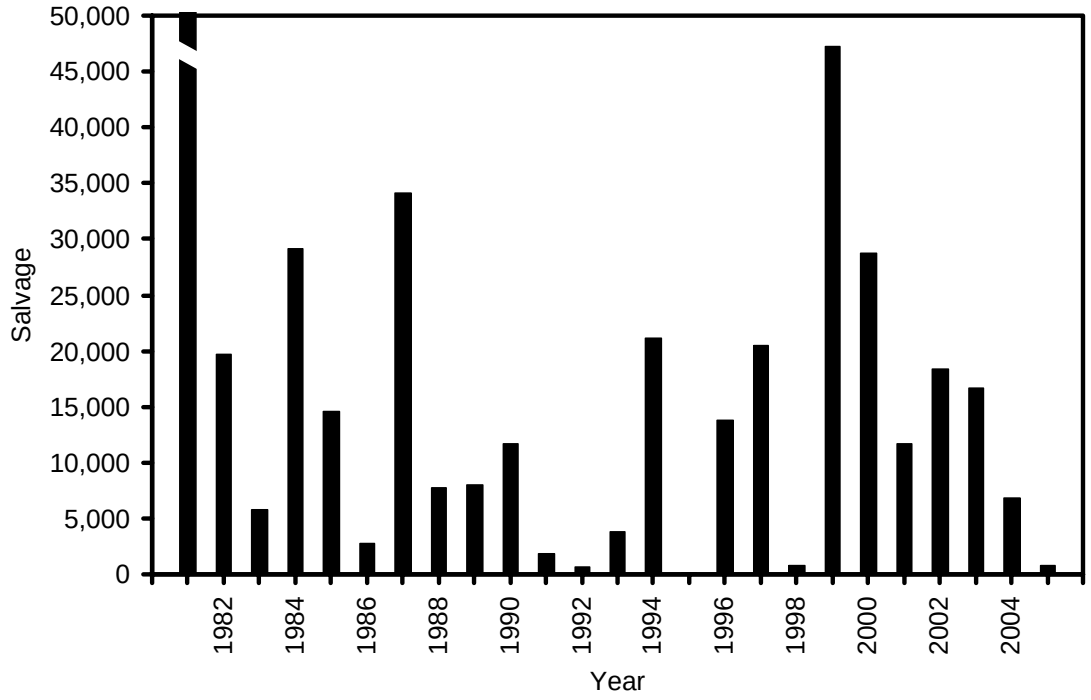

Figure 4. Annual salvage (salvage) of delta smelt at the Federal Facility, 1981 – 2005. The salvage in 1981 (274,288) has been truncated for scale considerations.

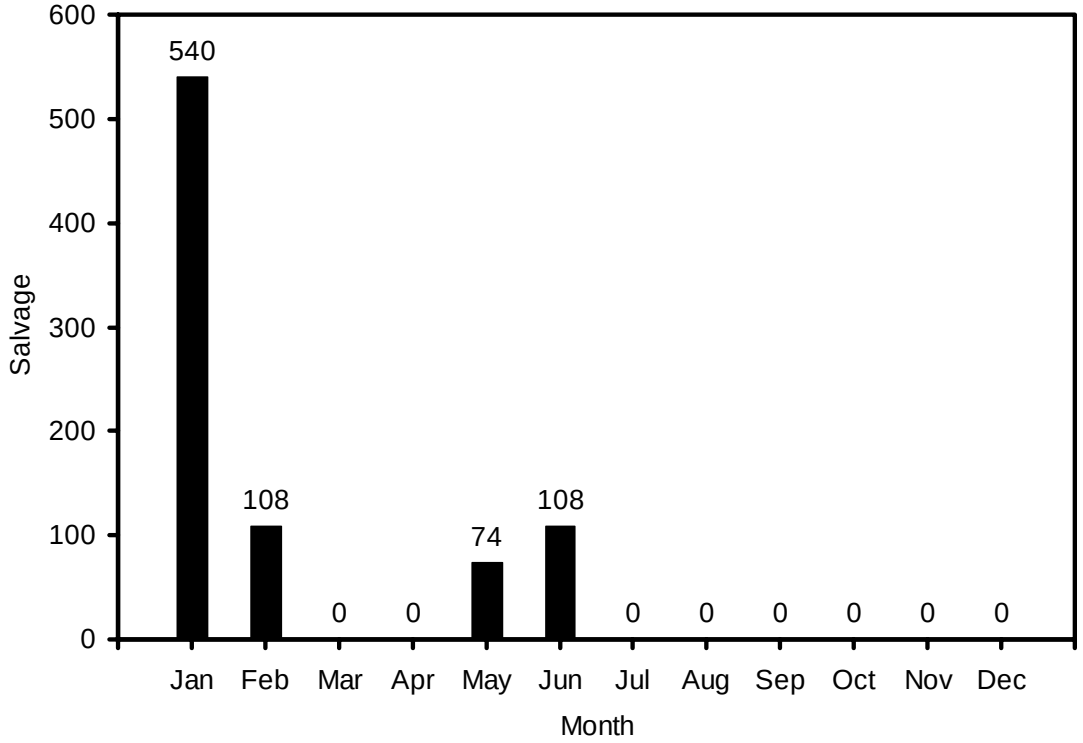

Figure 5. Monthly salvage (salvage) of delta smelt at the Federal Facility, 2005.

Chinook Salmon

The annual salvage and loss of Chinook salmon in 2005 consisted primarily of wild, fall and spring run juveniles. The combined salvage (wild, hatchery, and unknown origin) of Chinook salmon was 25,637 in 2005 and continuing the trend in low salvage starting in 2001 (Figure 6).

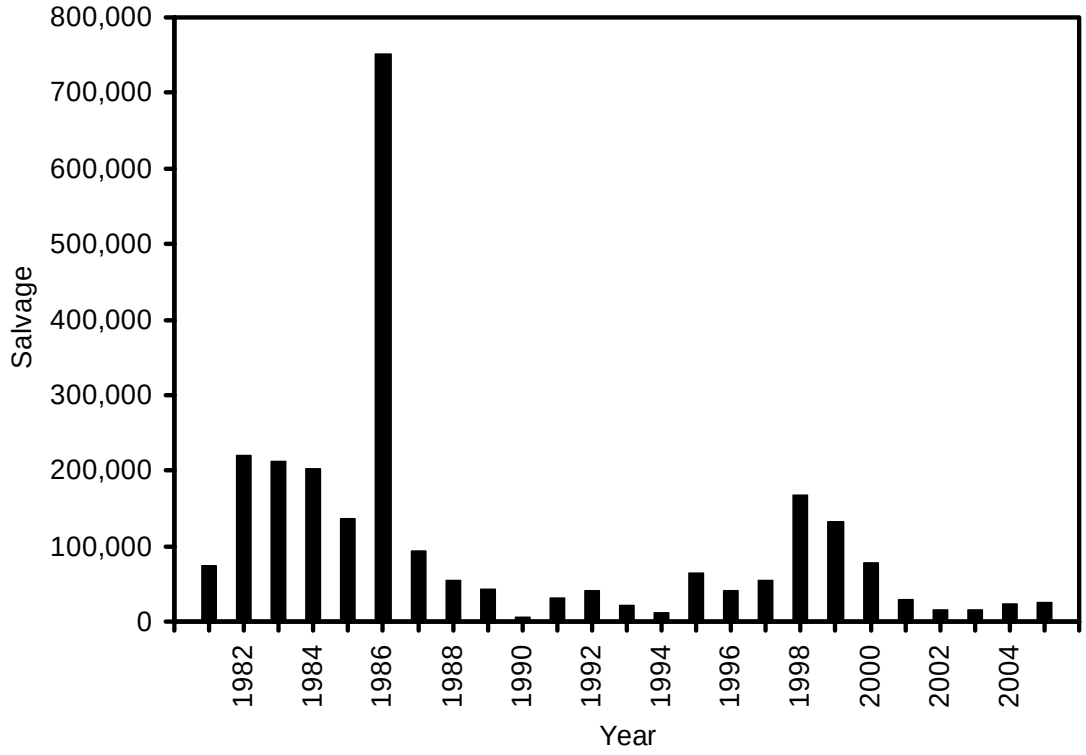

Figure 6. Annual combined salvage (salvage) of Chinook salmon at the Federal Facility, 1981 – 2005.

The Federal Facility salvaged 19,963 wild fish, 5,662 hatchery fish, and 12 fish of unknown origin. The salvage of wild fish occurred primarily from January through June, peaking April (Figure 7). The salvage of wild fish by race was:

- fall run – 9,409
- late-fall run – 84
- spring run – 10,245
- winter run – 225

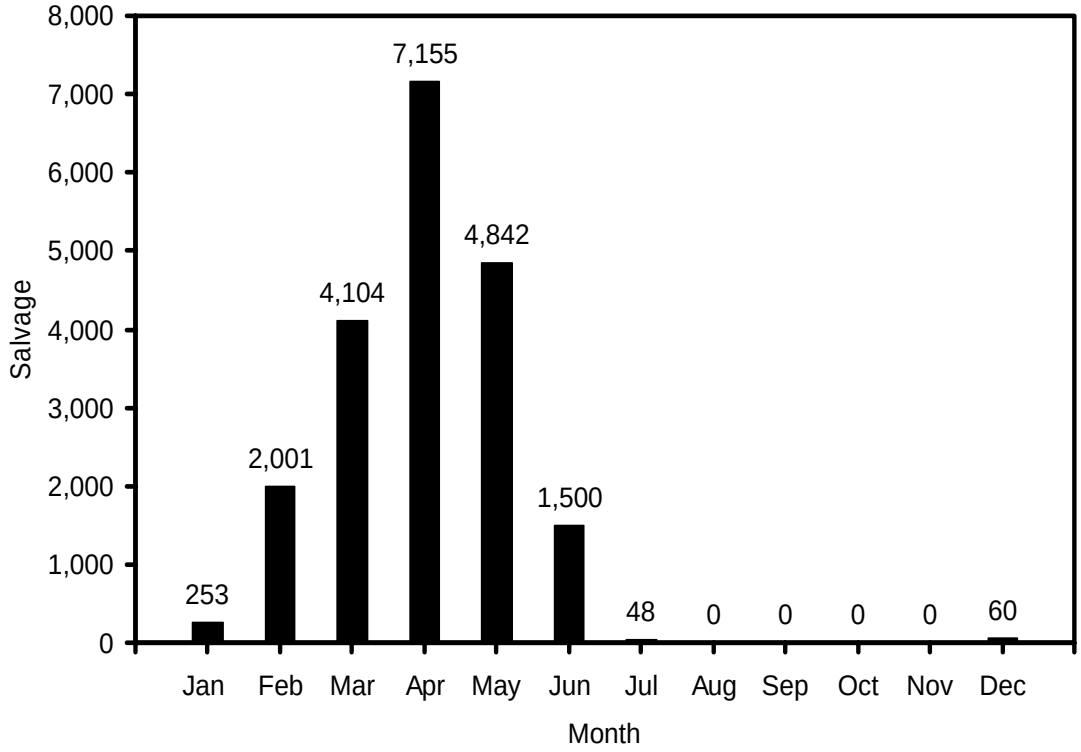

Figure 7. Monthly salvage (salvage) of wild Chinook salmon at the Federal Facility, 2005.

The loss (an estimate of mortality resulting from entrainment) was primarily composed of wild, fall and spring run fish. The loss of wild fish was 14,664 and the loss of hatchery fish was 4,298. The loss of wild fish by race was:

- fall run – 6,718
- late-fall run – 54
- spring run – 7,742
- winter run – 150

Steelhead

The salvage of steelhead at the Federal Facility in 2005 was low and primarily composed of hatchery fish. The Federal Facility salvaged 793 hatchery, 518 wild, and 36 of unknown origin for a combined salvage of 1,347 steelhead; 26% of the salvage in 2004 (5,186). The combined salvage in 2005 continued a declining trend that started in 2003 (Figure 8).

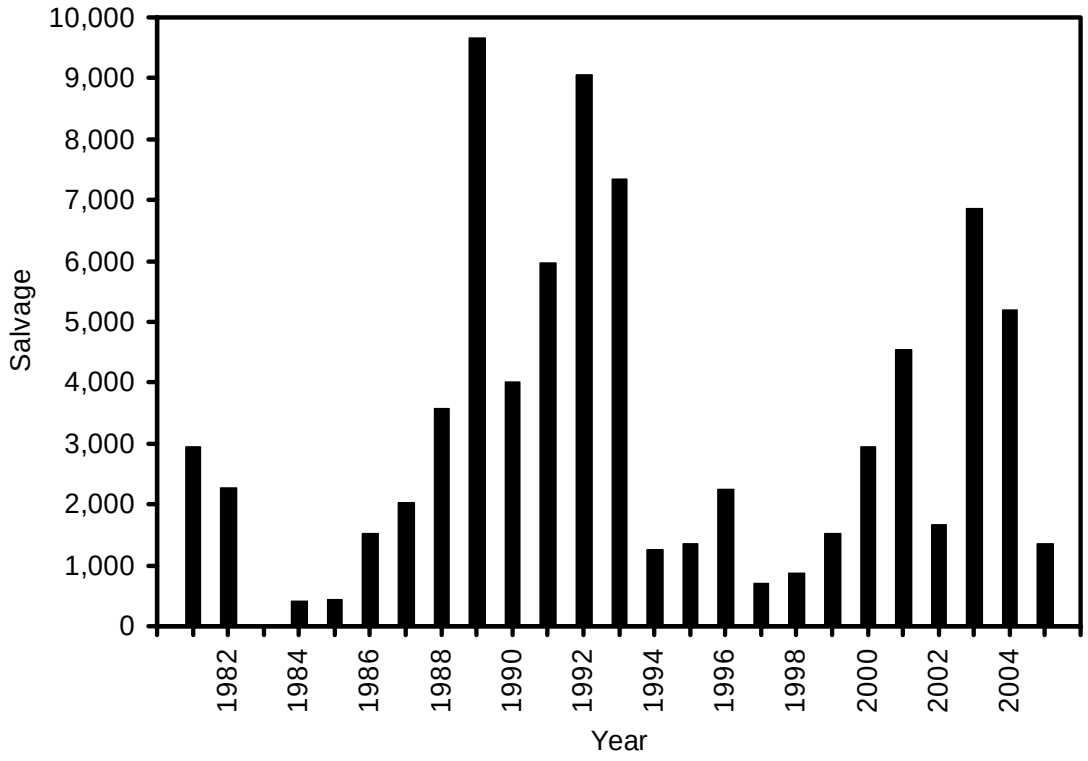

Figure 8. Annual combined salvage (salvage) of steelhead at the Federal Facility, 1981 – 2005.

The monthly salvage of wild fish ranged from January through July while for hatchery fish the monthly salvaged ranged from January through May (Figure 9). The monthly salvage of wild and hatchery fish, more or less, peak together in February and March (Figure 9). These 2 months accounted for 58% of the salvage of wild fish and 85% of the salvage of hatchery fish (Figure 9).

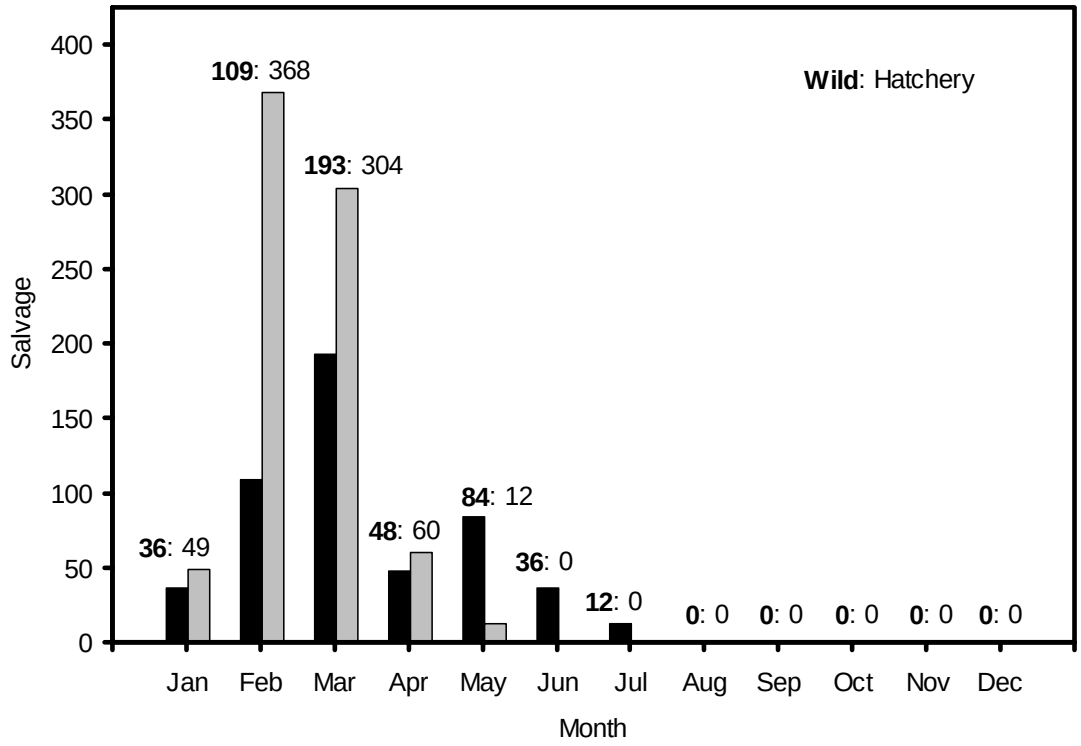

Figure 9. Monthly salvage (salvage) of wild and hatchery steelhead at the Federal Facility, 2005.

Striped Bass

The annual salvage of striped bass in 2005 was very low. The Federal Facility salvaged 124,537 striped bass, a new low for the period since 1981 and a continuation of low values since 1995 (Figure 10). The annual salvage in 2005 is 23% of annual salvage in 2004 (542,072). Prior to 1995, the annual salvages of striped bass were often greater than 1,000,000 (Figure 10). Since 1994, this has happened only once, in 2001 (Figure 10).

The monthly salvage of striped bass predominately occurred in 2 pulses: January – March and June – December (Figure 11). Monthly salvage ranged from 199 in May to 33,160 in June (Figure 11).

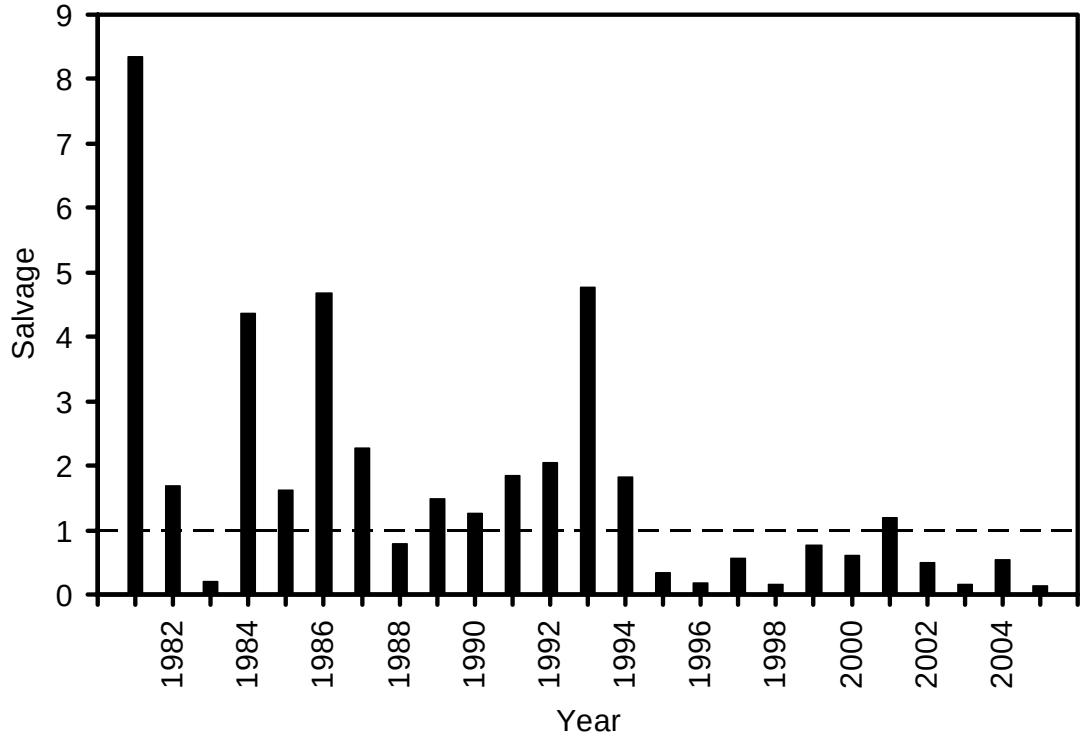

Figure 10. Annual salvage (salvage, in millions) of striped bass at the Federal Facility, 1981 – 2005.

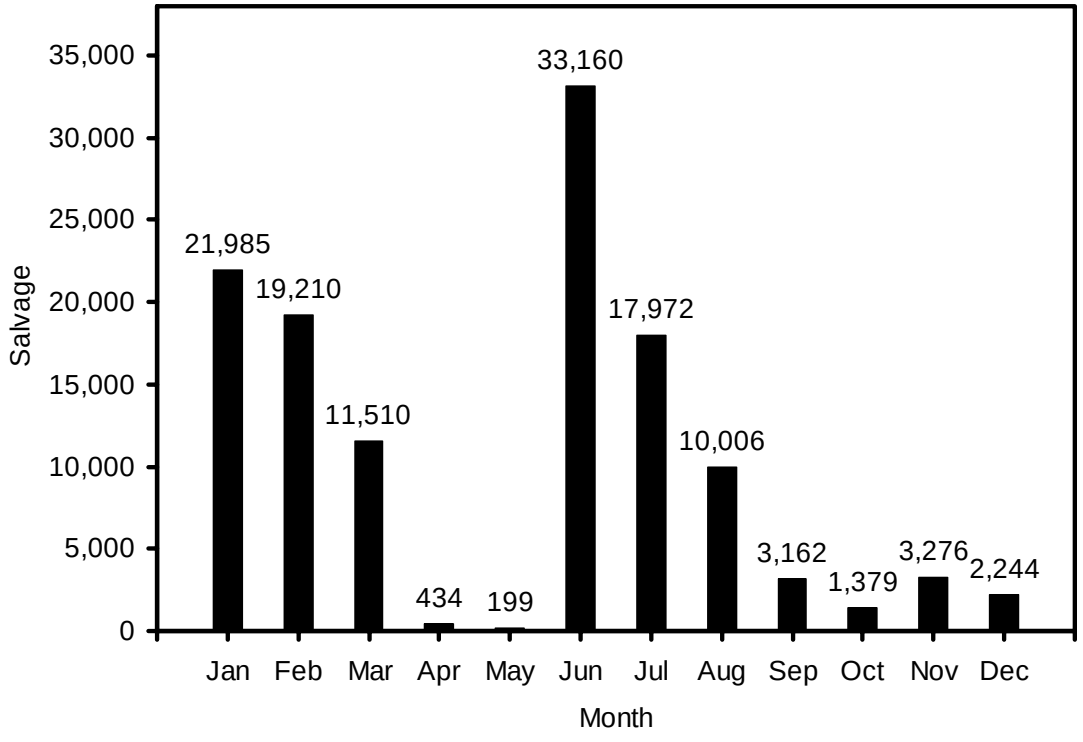

Figure 11. Monthly salvage (salvage) of striped bass at the Federal Facility, 2005.

American Shad

The salvage of American shad at the Federal Facility in 2005 was 329,047 and the continuation of a decline since 2003 (Figure 12). The annual salvage in 2005 was 77% of the annual salvage in 2004 (429,978).

American shad were salvaged from January through March and from June through December (Figure 13). Monthly salvaged ranged from 0 in April and May to 144,582 in November. The salvage in November accounted for 44% of the annual salvage.

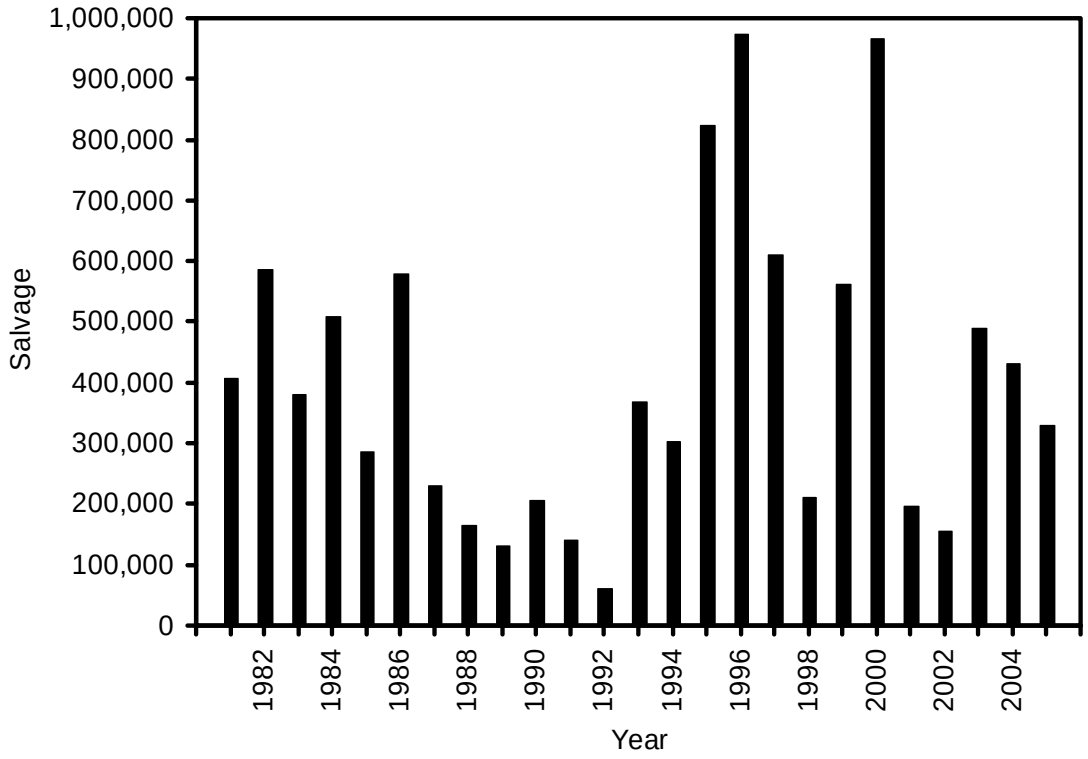

Figure 12. Annual salvage (salvage) of American shad at the Federal Facility, 1981 - 2005

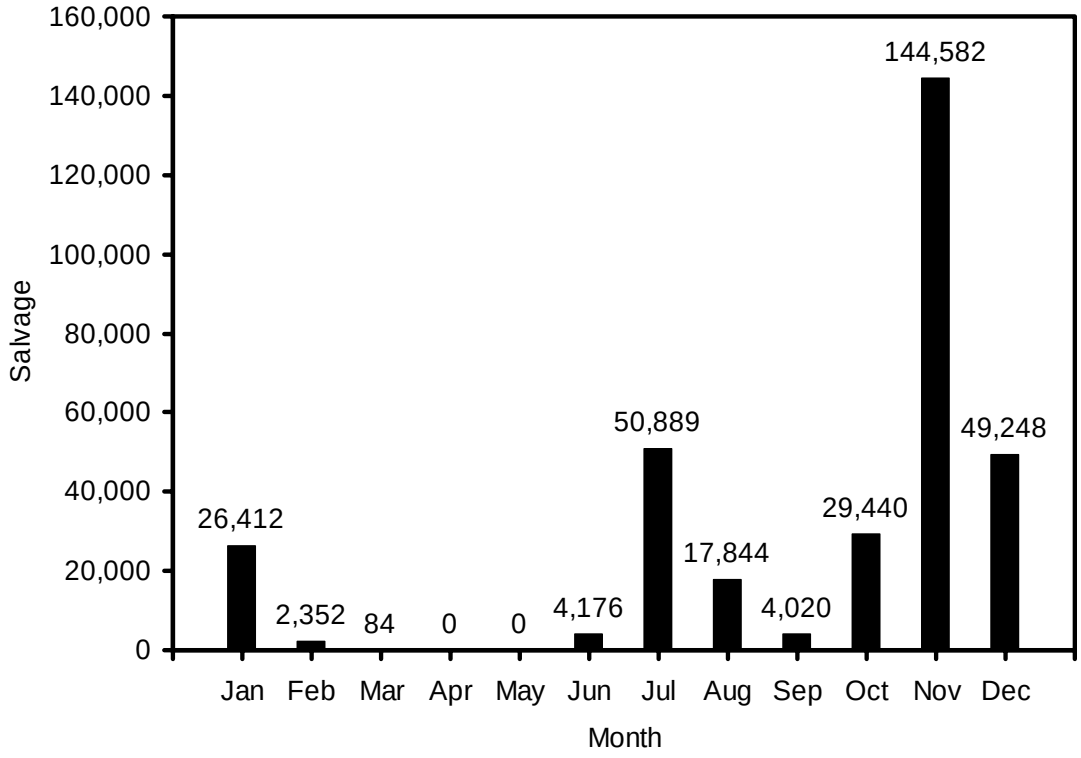

Figure 13. Monthly salvage (salvage) of American shad at the Federal Facility, 2005.

Sacramento Splittail

The annual salvage of Sacramento splittail at Federal Facility was high in 2005, but did not approach record high values. The Federal Facility salvaged 342,655 splittail in 2005, 26 times the annual salvage in 2004 (13,131). However, the salvage in 2005 is dwarfed by all time record salvages in 1986, 1995, and 1998. The majority of annual salvage values are less than 150,000 (Figure 14).

The majority of splittail salvage was confined to a narrow time frame, May – July (Figure 15), with the salvage comprised primary of age-0 fish. Salvage from May – July accounted for 99% of the annual salvage with June accounting for 85% of the annual salvage. Length ranged from 20 – 395 mm FL. However, 95th percentiles occurred at 82 mm FL.

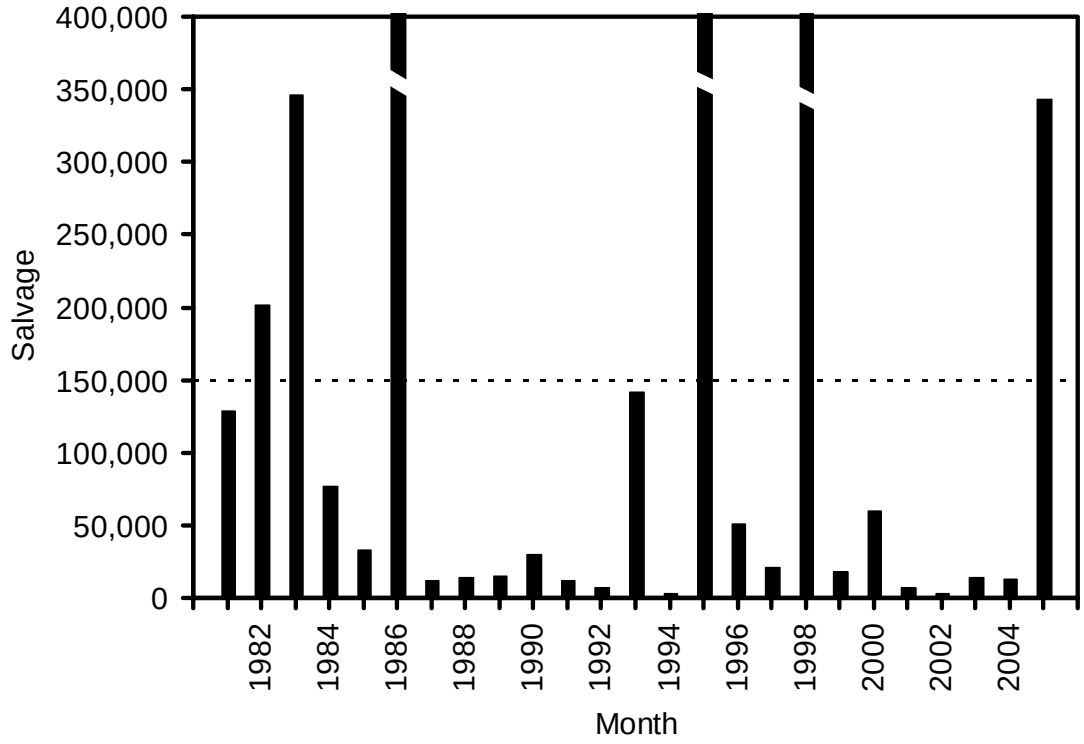

Figure 14. Annual salvage (salvage) of splittail at the Federal Facility, 1981 – 2005. The salvages for 1986 (1,231,283), 1995 (3,143,156), and 1998 (2,051,660) have been truncated for scale considerations.

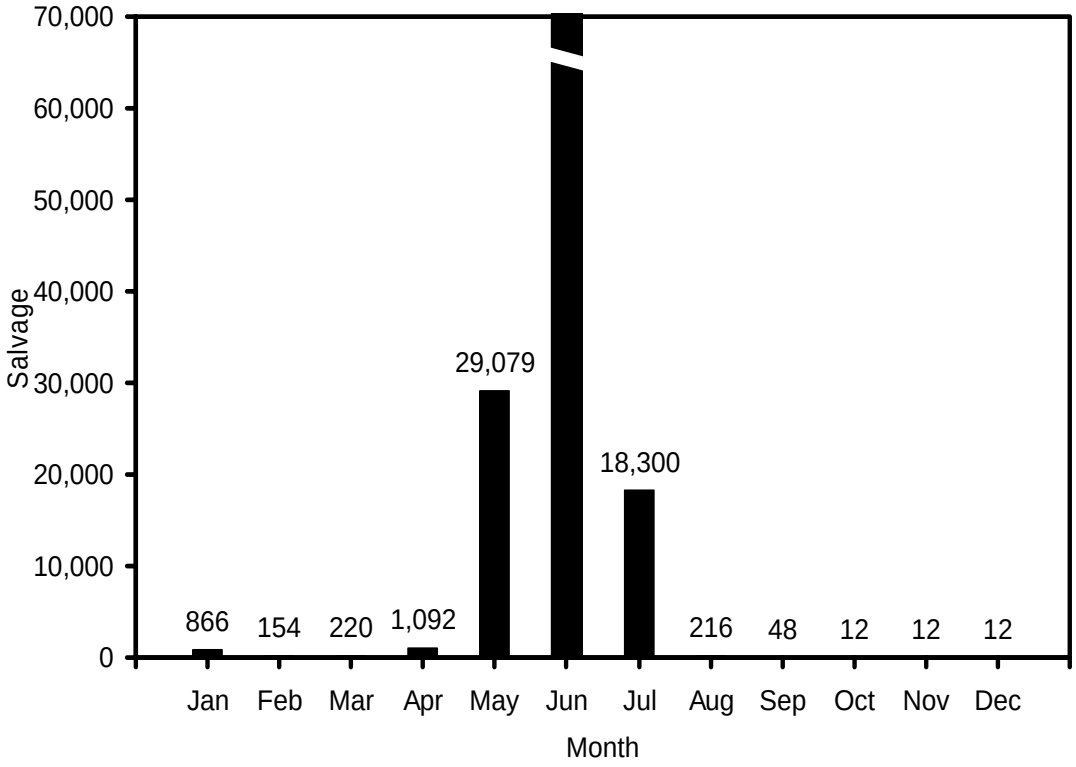

Figure 15. Monthly salvage (salvage) of splittail at the Federal Facility, 2005. The salvage in June (292,644) has been truncated for scale considerations.

Longfin Smelt

The salvage of longfin smelt in 2005 was low, 36, and only 6% of the annual salvage in 2004 (648). However, low salvage has been typical at the Federal Facility with the lowest salvages for the period of record, 1981 - 2004, were 0 in 1982 and 1995. Generally, annual salvages of longfin smelt have been low since 1990 with the exception of 1994 and 2001-2003 (Figure 16). The occurrences of large salvages (over 10,000) has occurred only once since 1990, in 2002 (Figure 16).

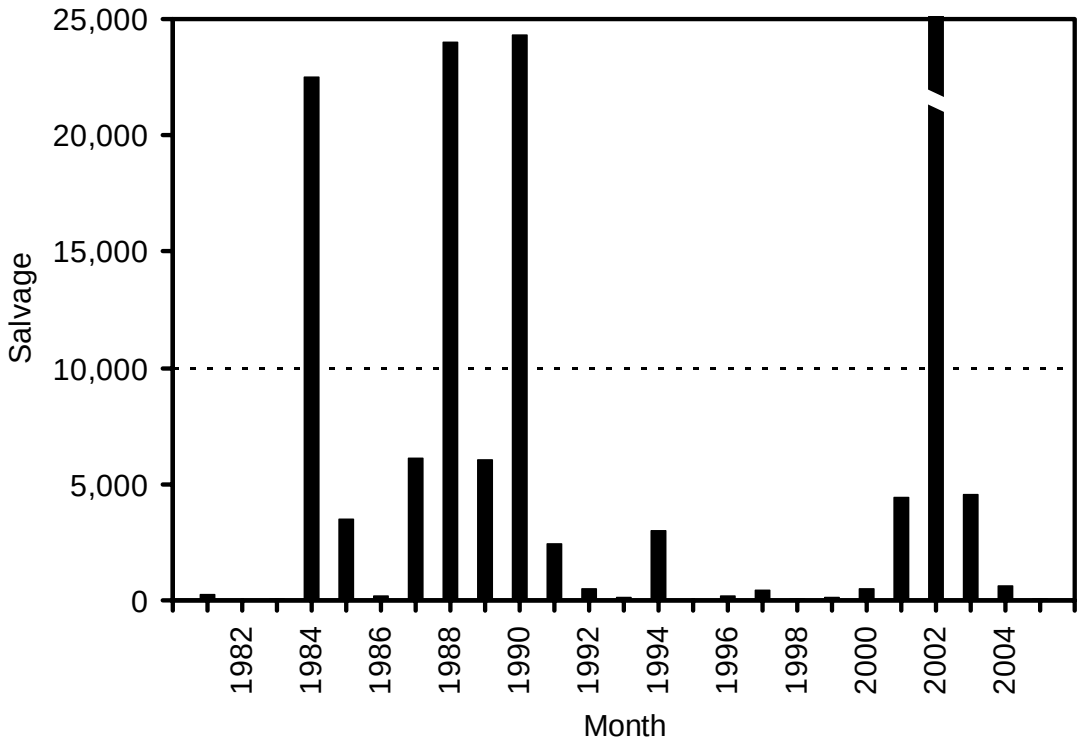

Figure 16. Annual salvage (salvage) of longfin smelt at the Federal Facility, 1981 – 2005. The salvage for 2002 (43,080) has been truncated for scale considerations.

Chinese Mitten Crabs

Mitten crab salvage in 2005 was the lowest recorded since 1999, 48 (Figure 17). Chinese mitten crabs have been less than 1% of the annual salvage for each facility in any given year since 1999. In 2005 mitten crabs were salvaged on January 6, 19, 21, and 31.

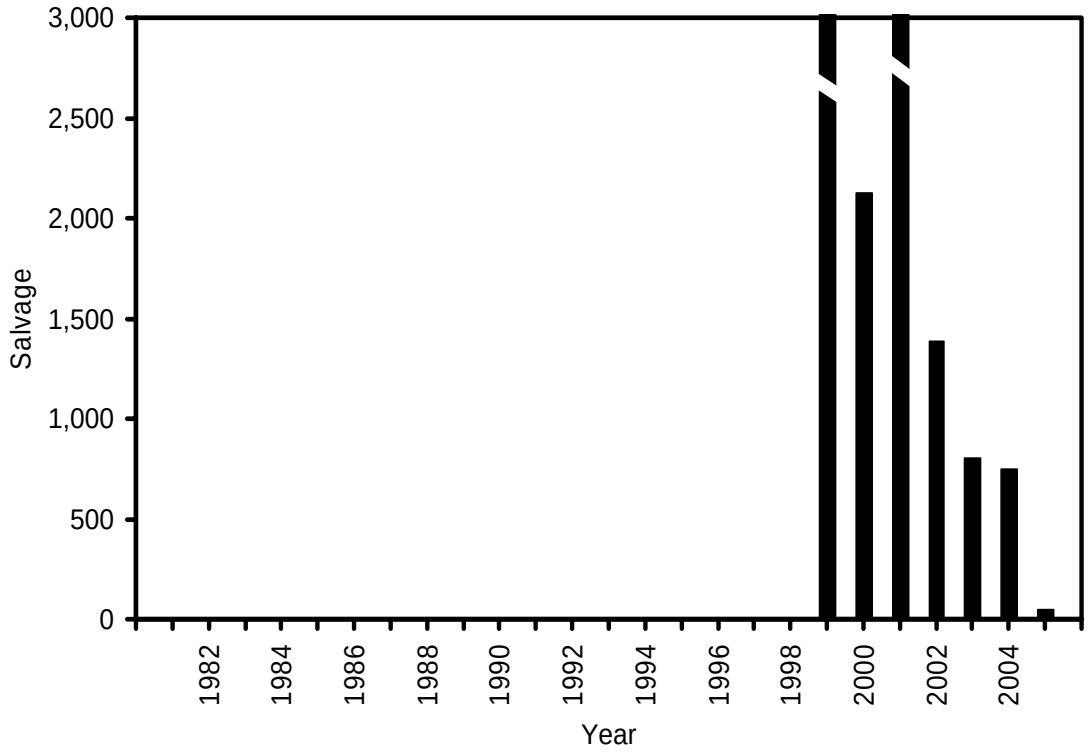

Figure 17. Annual salvage (salvage) of mitten crabs at the Federal Facility, 1999 – 2005. The salvages in 1999 (25,104) and 2001 (18,144) have been truncated for scale considerations.

Threadfin Shad

The 2005 annual salvage of threadfin shad at the Federal Facility, 1,111,293 was 26% of the annual salvage in 2004 (4,284,220), continuing the decline started in 2003. From 1994 – 2003, the overall trend was for threadfin shad annual salvage to rise (Figure 18). It is unknown if the declining trend from 2003 – 2005 will continue (Figure 18). Given their declining numbers, their percentage of annual salvage has concurrently declined (Figure 2)

Threadfin shad were salvaged in every month in 2005. Salvage ranged from 168 in May to 341,520 in September (Figure 19). The last half of 2005 accounted for the majority of the annual salvage (Figure 19).

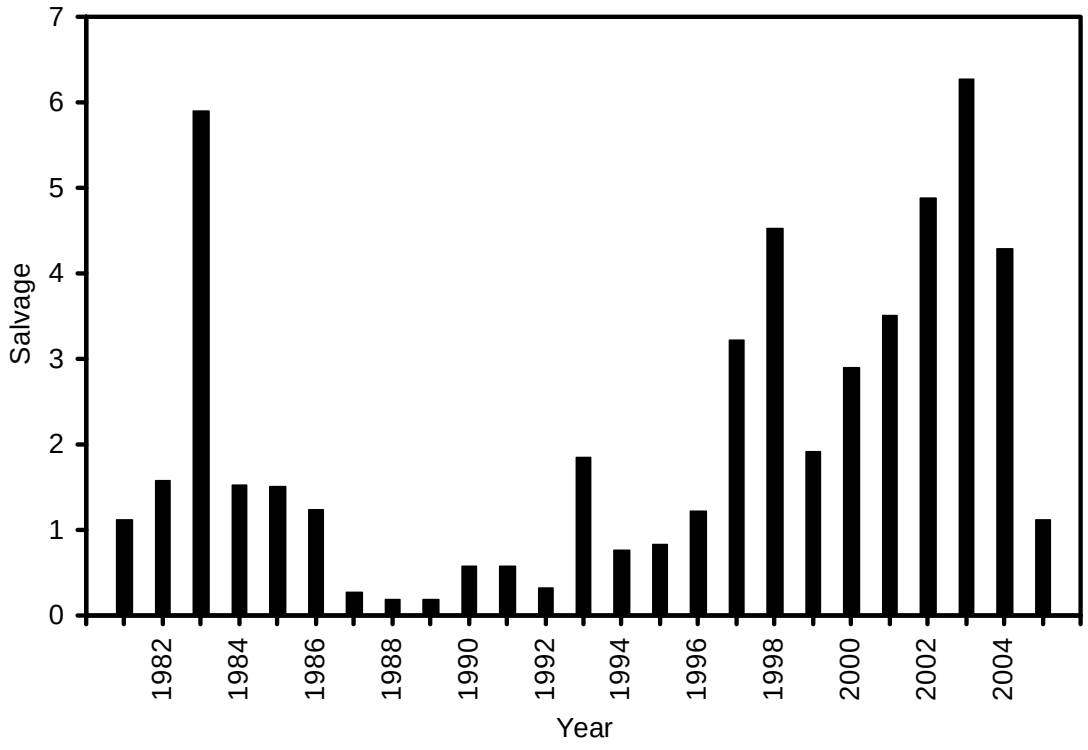

Figure 18. Annual salvage (salvage, in millions) of threadfin shad at the Federal Facility, 1981 – 2005.

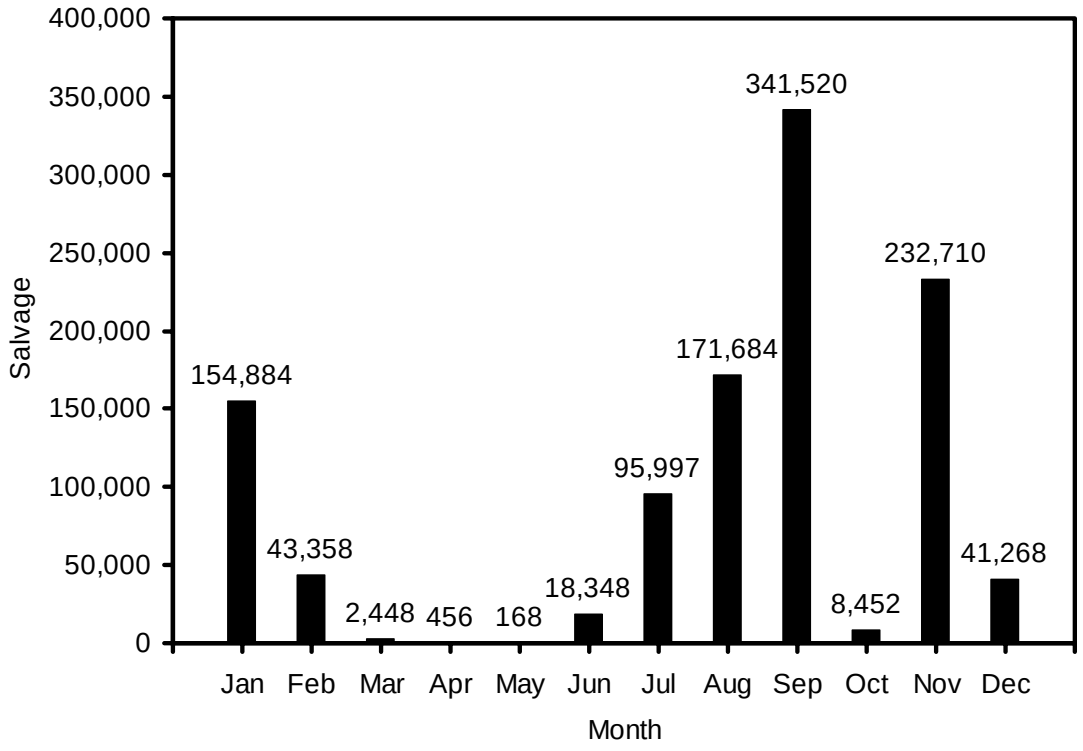

Figure 19. Monthly salvage (salvage) of threadfin shad at the Federal Facility, 2005.

Inland Silversides

The 2005 salvage of inland silversides was far less than the previous year and may represent the declining limb of a mode. The annual total was 22,686 or 44% of the annual salvage in 2004 (51,865). From 1981 – 2005 there are at least 2 modes and possibly a third. The first mode is qualitatively defined as from 1981 – 1988, the second mode from 1989 – 1997 and the potential third mode from 1999 and onwards (Figure 20).

Interestingly, the peaks in the modes of annual salvage have declined through time. The peak for the first mode was 128,674 (1982). The peak in the second mode was 74,536 (1992) and the peak in the potential third mode was 51,865 (2004) (Figure 20).

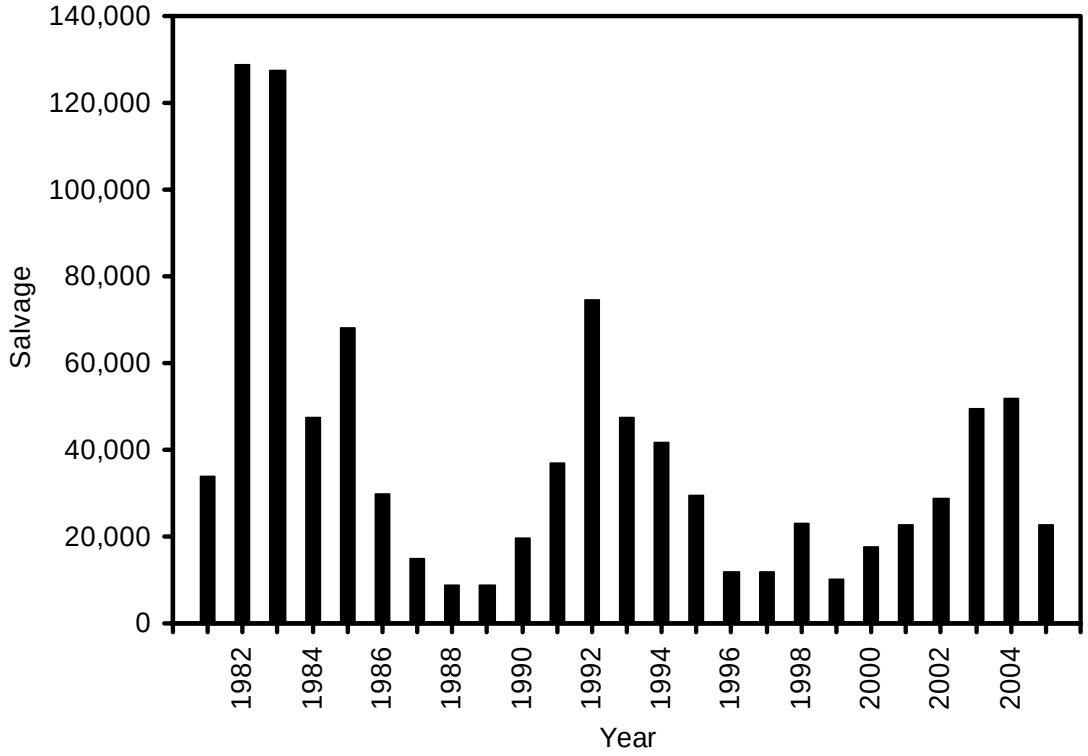

Figure 20. Annual salvage (salvage) of inland silversides at the Federal Facility, 1981 – 2005.

Monthly salvage of inland silversides was concentrated in the winter months, January – March and November – December, accounting for 90% of the annual salvage (Figure 21). The monthly salvage in January contributed to 44% of the annual salvage. However, inland silversides were seen in every month in 2005 except for May (Figure 21).

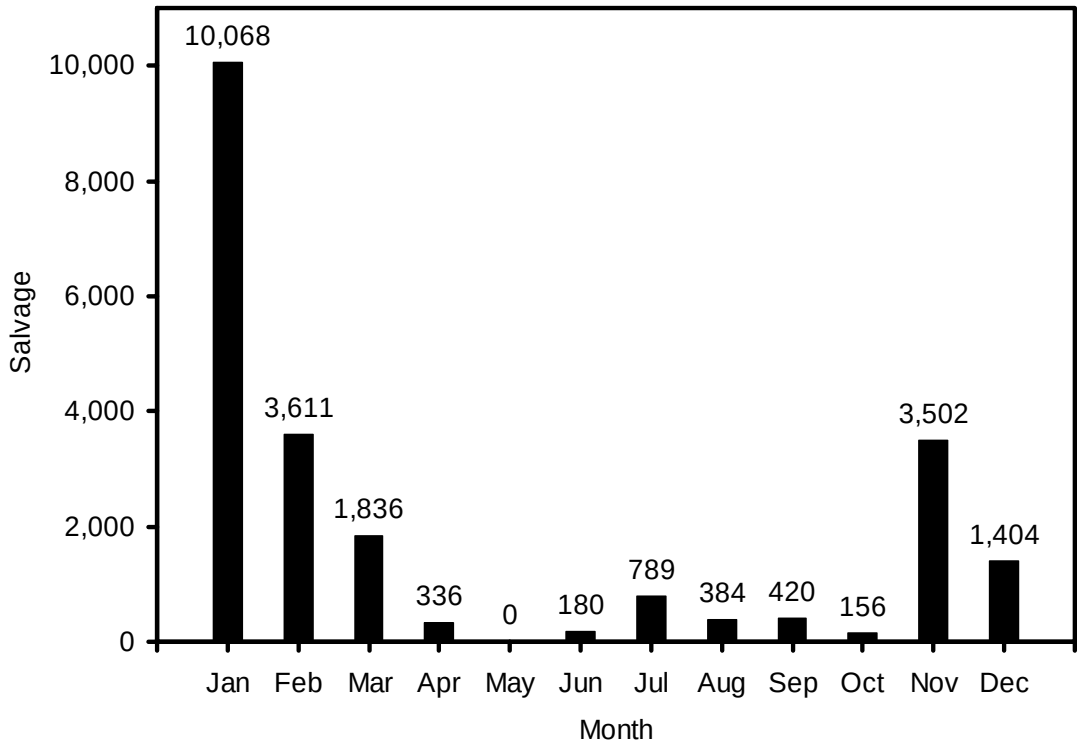

Figure 21. Monthly salvage of inland silversides at the Federal Facility, 2005.

Temperature

Mean daily temperature generally increased and peaked in July and then decreased until December (Figure 21). Mean daily temperature at the Federal Facility ranged from 8 – 26 ^{o}C with an annual daily mean temperature of 17 ^{o}C.

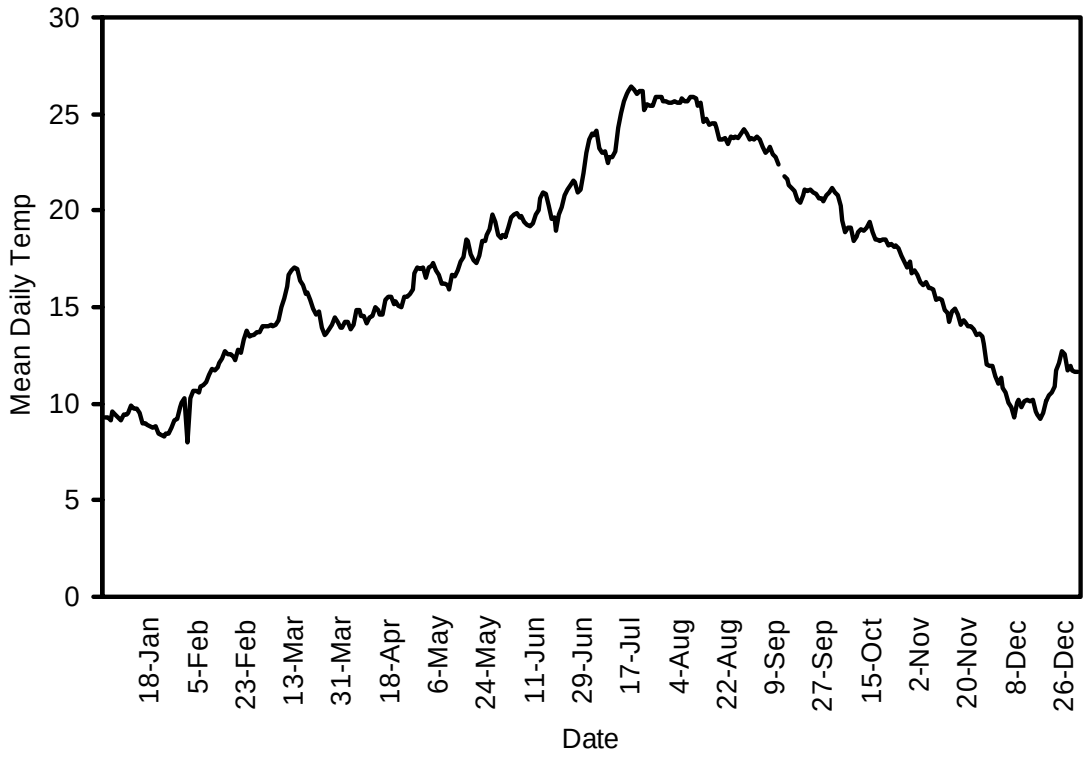

Figure 21. Mean daily temperature (^{o}C) for the Federal Facility, 2005.

Appendix Table A1. Annual salvage (salvage) and percentage of annual salvage (percentage) for the Federal Facility in 2005 and 2004.

	2005		2004	
Species	Salvage	%	Salvage	%
Threadfin Shad	1,111,293	45.7	4,284,220	73.0
Splittail	342,655	14.1	13,131	0.2
American Shad	329,047	13.5	429,978	7.3
Bluegill	181,033	7.5	161,063	2.7
White Catfish	169,889	7.0	138,270	2.4
Striped Bass	124,537	5.1	542,072	9.2
Yellowfin Goby	44,516	1.8	140,533	2.4
Chinook Salmon[1]	25,637	1.1	24,217	0.4
Channel Catfish	22,769	0.9	15,915	0.3
Inland Silverside	22,686	0.9	51,865	0.9
Largemouth Bass	22,523	0.9	37,344	0.6
Common Carp	6,097	0.3	1,671	<0.1
Golden Shiner	5,061	0.2	3,004	0.1
Shimofuri Goby	4,350	0.2	819	<0.1
Black Crappie	3,751	0.2	1,117	<0.1
Lamprey Unknown	2,664	0.1	360	<0.1
Prickly Sculpin	2,525	0.1	2,176	<0.1
Sacramento Sucker	2,028	0.1	0	0.0
Redear Sunfish	1,653	0.1	1,663	<0.1
Steelhead[1]	1,347	0.1	5,186	0.1
Delta Smelt	830	<0.1	6,769	0.1
Warmouth	673	<0.1	1,092	<0.1
Western Mosquitofish	444	<0.1	108	<0.1
Bigscale Logperch	277	<0.1	554	<0.1
Black Bullhead	237	<0.1	267	<0.1
Brown Bullhead	204	<0.1	496	<0.1
Riffle Sculpin	192	<0.1	12	<0.1
Fathead Minnow	168	<0.1	36	<0.1
Tule Perch	144	<0.1	204	<0.1
Threespine Stickleback	133	<0.1	84	<0.1
Goldfish	108	<0.1	0	0.0
Green Sunfish	78	<0.1	13	<0.1
Sacramento Pikeminnow	48	<0.1	0	0.0
White Bass	48	<0.1	36	<0.1
Red Shiner	48	<0.1	540	<0.1
Chinese Mitten Crab	48	<0.1	745	<0.1
Rainwater Killifish	40	<0.1	144	<0.1
Longfin Smelt	36	<0.1	648	<0.1
Starry Flounder	36	<0.1	312	<0.1
White Crappie	36	<0.1	264	<0.1
Sacramento Blackfish	24	<0.1	12	<0.1
Pacific Staghorn Sculpin	24	<0.1	24	<0.1
Green Sturgeon	12	<0.1	0	0.0
Smallmouth Bass	12	<0.1	12	<0.1
Shokihaze Goby	12	<0.1	12	<0.1
Hitch	0	0.0	12	<0.1
White Sturgeon	0	0.0	24	<0.1
Blue Catfish	0	0.0	36	<0.1

Appendix Table 1 (continued)

	2005		2004	
Species	Salvage	%	Salvage	%
Wakasagi	0	0.0	12	<0.1
Spotted Bass	0	0.0	156	<0.1

1. Combined salvage of wild, hatchery and fish of unknown origin.