

**LOWER MOKELUMNE RIVER
UPSTREAM FISH MIGRATION MONITORING
Conducted at Woodbridge Irrigation District Dam
August 2002 through July 2003**

August 2003

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Key words: lower Mokelumne River, fall-run Chinook salmon, steelhead, escapement

Abstract: This report summarizes data collected below Woodbridge Irrigation District Dam (WIDD) on the lower Mokelumne River (LMR) from August 18, 2002 through July 31, 2003. An estimated 10,755 fall-run Chinook salmon (*Oncorhynchus tshawytscha*) passed the WIDD fish ladders between September, 2002 and January, 2003. Fifty percent of the run passed WIDD by November 7, 2002 as compared to November 11th of last year. Highest daily passage was 662 on November 7, 2002. The sex and life stage was positively determined for 10,713 salmon and included 4,271 (40%) adult females, 4,240 (40%) adult males, 521 (5%) grilse females and 1,681 (15%) grilse males. Fifty-six adult steelhead (*O. mykiss*) passed WIDD between November 2002 and April 2003. Peak steelhead passage occurred in January. Other species using the WIDD fishways included: American shad, *Alosa sapidissima*; black bass, *Micropterus sp.*; channel catfish, *Ictalurus punctatus*; chum salmon, *O. keta*; common carp, *Cyprinus carpio*; goldfish, *Carassius auratus*; Pacific lamprey, *Lampetra tridentata*; Sacramento blackfish, *Orthodon microlepidotus*; Sacramento pikeminnow, *Ptychocheilus grandis*; Sacramento sucker, *Catostomus occidentalis*; and tule perch, *Hysterocarpus traski*.

INTRODUCTION

East Bay Municipal Utility District (EBMUD) has been monitoring adult fall-run Chinook salmon escapement in the lower Mokelumne River (LMR) using video surveillance and trapping at Woodbridge Irrigation District Dam (WIDD) since the fall of 1990. Initially, monitoring documented the timing and magnitude of the adult salmon escapement to the LMR with a secondary focus on steelhead. Monitoring has started between August and mid-October, and ended between December and April in previous years. This season represents the second year of 12 months of continuous monitoring.

OBJECTIVES

The objectives of this study are to monitor fish passage of native and non-native fishes through the WIDD fish ladders and describe the relationship of fall-run Chinook salmon movements to environmental conditions on the LMR.

METHODS

EBMUD's monitoring of fall-run Chinook salmon migration began on August 16, 2002 with video monitoring in the high stage ladder at the WIDD. On November 4, Woodbridge Irrigation District (WID) began removing the boards in the dam, which necessitated operation of the low stage ladder. EBMUD began trapping and video monitoring in the low-stage ladder on November 6, 2002. Trapping and video monitoring continued until January 2, 2003 when trapping was discontinued. Video monitoring in the low stage ladder continued to March 13, 2002. Monitoring in the high stage was resumed on March 18, 2002, when the boards of WID were installed, and continued through July 31, 2002.

All other monitoring, and data collection and storage methods were consistent with prior year's monitoring efforts (Marine and Vogel 2000, Workman 2001).

RESULTS AND DISCUSSION

Native Anadromous Fish

Chinook Salmon

The fall-run Chinook salmon escapement estimate in the LMR for 2002/2003 is 10,755 spawners entering the river between September 2002 and January 2003 (Figure 1). Fifty percent of the run passed WIDD by November 7, 2002 as compared to November 11th of last year (Table 1). Highest daily passage of 662 fish occurred on November 7, 2002. The sex and life stage was positively determined for 10,713 fish including 4,271 (40%) adult (>60 cm FL) females, 4,240 (40%) adult males, 521 (5%) grilse (≤ 60 cm FL) females and 1,681 (15%) grilse males (Figure 2). In addition there were 2 unknown sex adults, 39 unknown sex grilse, and 1 unknown sex and size fish. Data are in Appendix A.

Length-frequency of the 2002 escapement is graphically depicted in Figure 3. Over the past twelve years combined length-frequency data has shown a 1:3 grilse to adult ratio, and the same ratio exists for 2002. Ninety-Five % of the fish this year were between the sizes of 60 cm and 94 cm. Over the past 12 years, 95% of fish were in the 55 cm to 94 cm range.

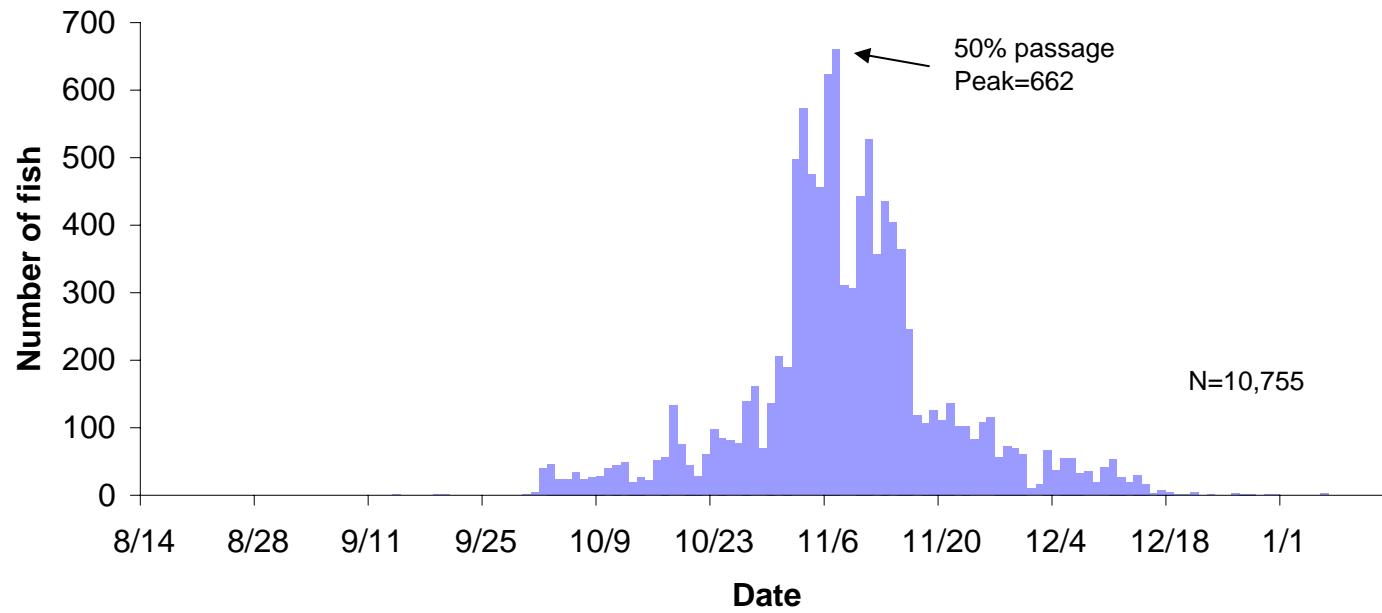


Figure 1. Daily abundance and timing of fall-run Chinook salmon migrating past Woodbridge Irrigation District Dam, August 14, 2002 - January 6, 2003. (Data in Appendix A)

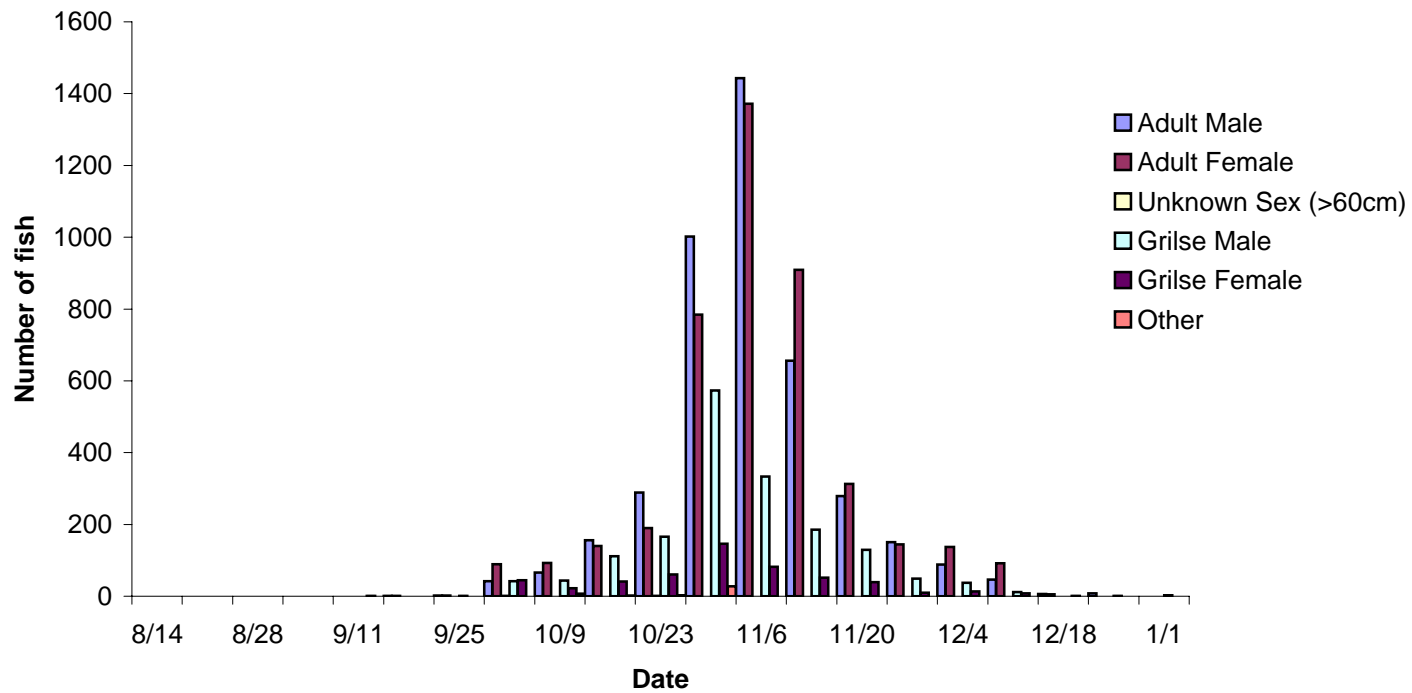


Figure 2. Weekly sex/age composition of fall-run Chinook salmon passing Woodbridge Irrigation District Dam, August 14, 2002- July 31, 2003. (Data in Appendix A)

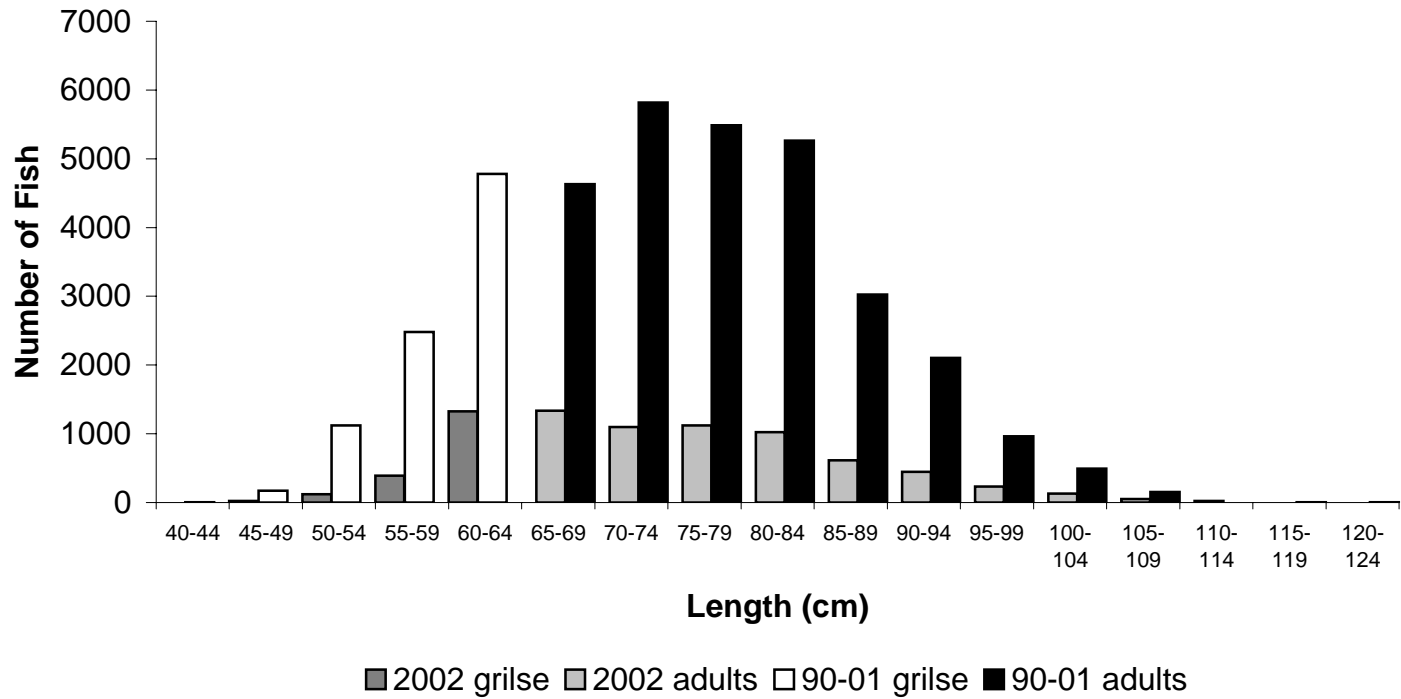


Figure 3. Length frequency of adult and grilse chinook salmon passing Woodbridge Irrigation District Dam in 2002 compared to the cumulative length frequency from 1990-2001.

Table 1. Dates when 50% of fall-run Chinook salmon passed the Woodbridge Irrigation District Dam, 1990-2001.

Year	10%	50%	90%
1990	Oct. 23	Nov. 18	Dec. 12
1991	n/a	n/a	n/a
1992	Oct. 28	Nov. 13	Dec. 2
1993	Oct. 22	Nov. 3	Nov. 21
1994	Oct. 21	Nov. 7	Dec. 2
1995	Sept. 28	Oct. 30	Nov. 23
1996	Oct. 18	Oct. 31	Nov. 20
1997	Oct. 15	Nov. 8	Nov. 22
1998	Oct. 11	Nov. 4	Nov. 24
1999	Oct. 16	Nov. 3	Nov. 20
2000	Oct. 12	Oct. 30	Nov. 16
2001	Oct. 29	Nov. 11	Nov. 25
2002	Oct. 24	Nov. 7	Nov. 24

Since 1990 more fish have passed upstream during daylight hours than nighttime hours (Table 2). Day is defined as ½ hour before sunrise to ½ hour after sunset.

In the 2002/2003 monitoring season, 55% of fish passing the video monitor occurred during the day, and 45% during the night. Daytime passage has been consistently higher than nighttime passage (Table 2). In 2000, passage was crepuscular, with peaks between 08:00-10:00 and 16:00-18:00 (Workman 2001). Data from this season and last showed only an early morning peak, but not a corresponding late afternoon peak (Figure 4).

Table 2. Percent of annual fall-run Chinook salmon passing Woodbridge Irrigation District Dam during day and night, 1990-2001.

<i>Year</i>	<i>1990</i>	<i>1991</i>	<i>1992</i>	<i>1993</i>	<i>1994</i>	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>
Day	57	64	69	59	61	68	52	56	56	62	68	58	55
Night	43	36	31	41	39	32	48	44	44	38	32	42	45

Clipped adipose fins were evident on 1,591 (15%) of the observed fall-run Chinook salmon. Of the identifiable grilse and adults 16.2% (363), and 14.4% (1,228), respectively, had adipose fin clips. The percentage of adipose clipped adults has ranged from 0.9% in 1993 to a high of 14.4% this season. The range for grilse has been from 1.7% in 1993 and 1997 to a high of 18.6% in 2001 (Table 3).

In addition to adipose-fin clips, observations of hook scars, fungal infections, abrasions, predator wounds and lacerations were recorded. Observations of hook scars this year, like last year, were lower than previous years. Hook scars in grilse were recorded for 0.3% of observable grilse. Hook scars in adults were recorded for 0.9% of observable adults. Other

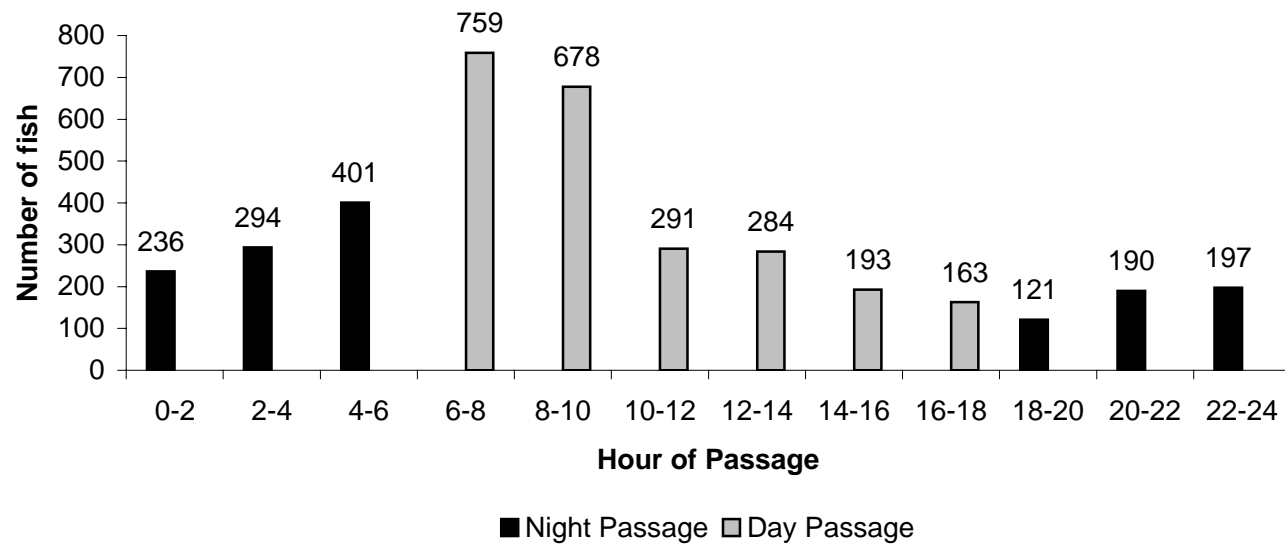


Figure 4. Chinook salmon passage (2 hour intervals) recorded from video monitoring at the Woodbridge Irrigation District Dam, August 14, 2002 - July 31, 2003.

injuries and anomalies were categorized as abrasions, fungal infections, lacerations, and predator wounds. The most frequent injury for both age classes was abrasions. Other injuries combined occurred in 15.6 % of adults and 5.8 % of grilse (Table 3).

Table 3. Incidence of adipose fin clips, hook-scars and injuries on adult fall-run Chinook salmon passing Woodbridge Irrigation District Dam, 1992-2002.

<u>Year</u>	<u>Adipose Fin Clips</u>		<u>Hook Scars</u>		<u>Other Injuries</u>	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Adult						
1992	10	1.4	24	3.4	20	2.8
1993	11	0.9	56	4.5	83	6.7
1994	244	10.3	151	6.3	218	9.2
1995	161	7.8	74	3.6	289	14.1
1996	169	9.2	97	5.3	258	14.1
1997/98	152	2.9	105	2	785	14.7
1998/99	427	7.4	38	1.2	615	10.7
1999/2000	327	10.8	46	1.5	392	13
2000/2001	225	4.0	87	1.2	855	11.7
2001/2002	326	8.5	36	0.9	594	15.6
2002/2003	1,228	14.4	68	.08	222	2.6
Grilse						
1992	35	3.8	41	4.4	21	2.3
1993	8	1.7	33	6.8	15	3.1
1994	22	4	59	10.6	27	4.9
1995	55	15.2	27	7.4	25	6.9
1996	47	3.5	68	5.0	44	3.2
1997/98	7	1.7	3	0.7	18	4.5
1998/99	175	12	9	1.1	55	3.8
1999/2000	139	6.1	46	2.0	160	7.0
2000/2001	83	8	7	0.5	71	5.5
2001/2002	188	18.6	3	0.3	58	5.8
2002/2003	363	16.2	11	0.4	25	1.1

River flow, rainfall, temperature, turbidity, and barometric pressure have been investigated for their relationship to salmon returns over the past 12 years. Regression analysis comparing these factors to number of fish on the ascending portion of the curve were run for the 2002/2003 escapement. All regression coefficients for environmental variable to number of fish, by date, appear in parenthesis following the variable description.

For the 2002/2003 chinook salmon migration period, defined here as 08/14/2002 through 1/14/2003, Camanche Dam releases ranged from 255-384 cfs (78-117 m³/s). Average flow was 283.2 cfs (86.3 m³/s) ($R^2= 0.09$, $p< .003$)(Figure 5a). Flows below WID ranged from 29-535 cfs (8.8-163 m³/s) and averaged 146.9 cfs (44.7 m³/s)($R^2=0.47$, $p<.0001$). Temperatures for the August through January monitoring period ranged from 51.9-60.8°F (11.1-16.0°C) at Camanche Dam ($R^2= 0.42$, $p< .0001$) and 48.7-71.6°F (9.3°-22.0°C) at WIDD($R^2= 0.46$, $p< .0001$) (Figure 5b). Turbidity increases in the LMR with rainfall. Total rainfall for the survey period was 6.0 inches (15.2 cm). Peak daily rainfall was 1.28 inches (3.25 cm)($R^2=0.21$, $p< .0001$). Turbidity ranged from 1.84 to 24.7 ntu ($R^2= 0.007$, $p<0.52$) (Figures 5c and 5d). The combined effects of temperature and flow at WIDD, and precipitation explain 64% of the variability in the number of salmon migrating upstream past WIDD ($p<0.001$).

Ninety-seven Chinook salmon 60 cm or larger were observed passing upstream through the Woodbridge fish ladders from March through July (Figure 6). Most were females (n=79) and twenty-one were adclipped.

Steelhead

Steelhead have been observed since monitoring began in 1990 (Table 5). In all years prior to 1997, adult monitoring ended in December. Spawning, however, typically occurs between January and March for winter steelhead in the Central Valley (IEP Steelhead PWT 1999).

Table 5. Steelhead observed moving upstream during video monitoring at Woodbridge Irrigation District Dam, 1990-2001.

<i>Monitoring Period</i>	<i>Number</i>	<i>Monitoring Period</i>	<i>Number</i>
Oct. - Dec. 1990	4	Sept. 1997 – Feb. 1998	6
Oct. - Dec. 1991	n/a	Aug. 1998 – Mar. 1999	12
Oct. - Dec. 1992	7	Aug. 1999 – Mar. 2000	80
Oct. - Dec. 1993	8	Aug. 2000 – Apr. 2001	48
Oct. - Dec. 1994	19	Aug. 2001 – July 2002	91
Sept. - Dec. 1995	76	Aug. 2002 – July 2003	62
Sept. - Dec. 1996	12		

Sixty-two adult steelhead (>350 mm FL) were observed moving upstream through WIDD from November 08, 2002 through May 16, 2003. Of the 62 observed, 27 were males, 21 were females, 17 were not distinguishable to sex, and 61 were adipose fin clipped. All adult steelhead, except for one male were adipose clipped. During this same time period five males, 5 unknown sex, and 2 females were observed moving downstream. It is unclear if these downstream migrants were spawned out fish returning to the ocean or just fish moving back and forth through the ladder. During June and July, 11 adult steelhead were observed moving downstream through the ladder and these are presumed to be adults migrating out as kelts.

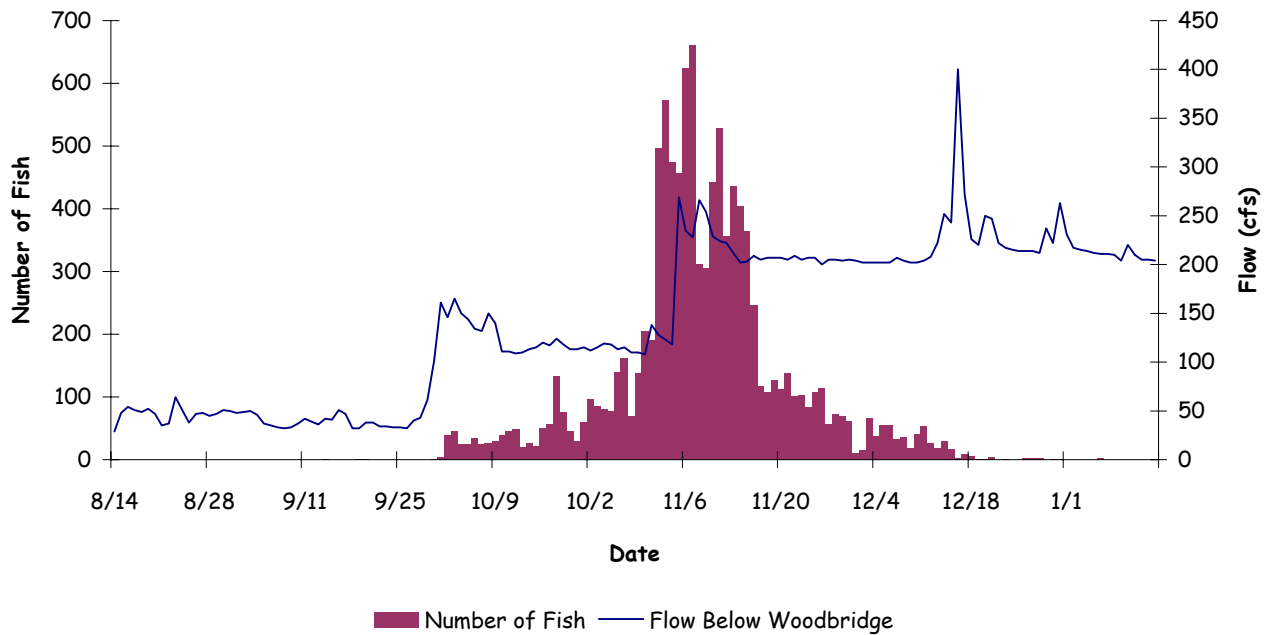
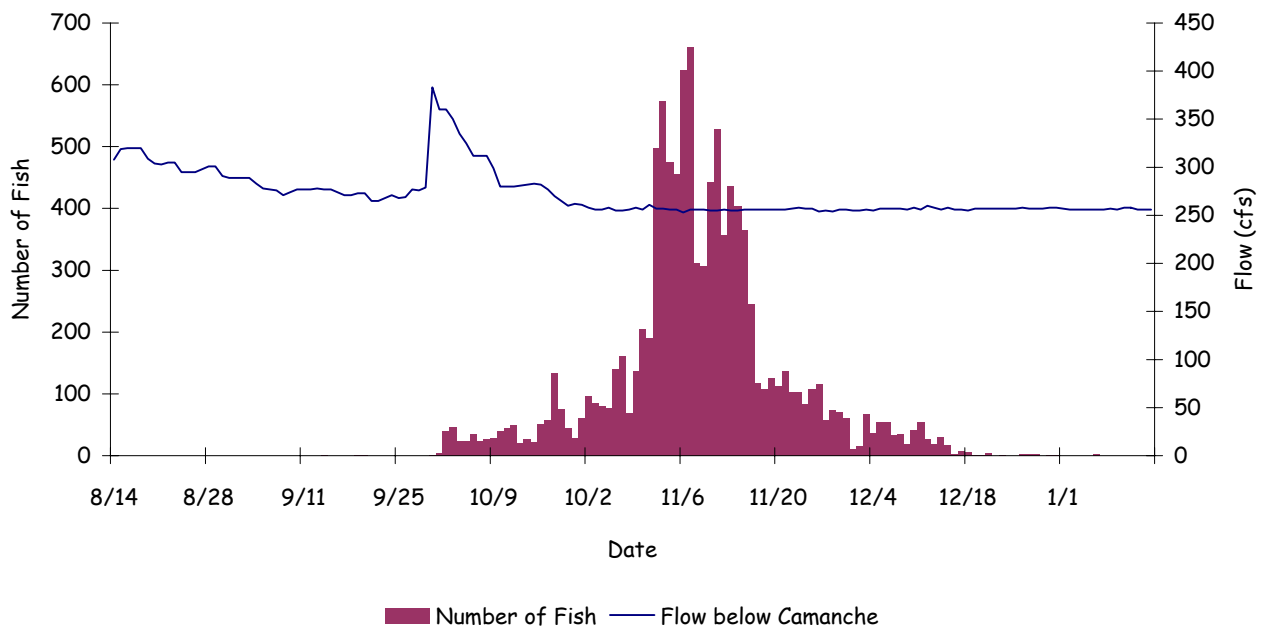


Figure 5a. Daily abundance of Chinook salmon passing Woodbridge Irrigation District Dam and flow, August 14, 2002-January 14, 2003.

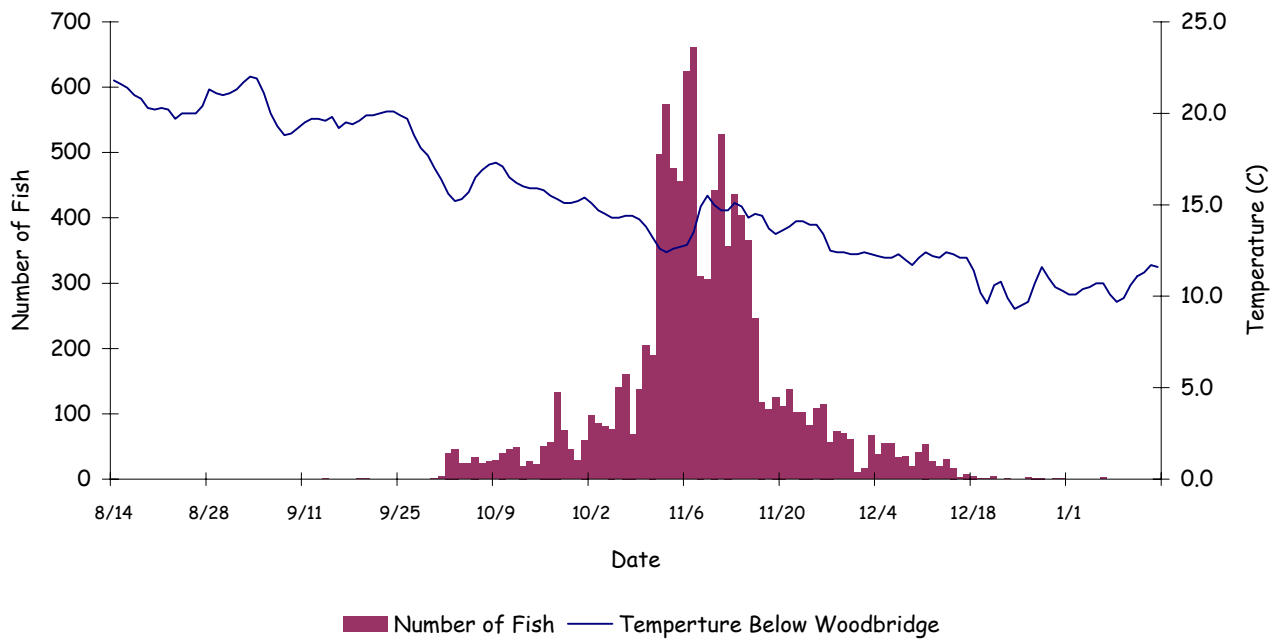
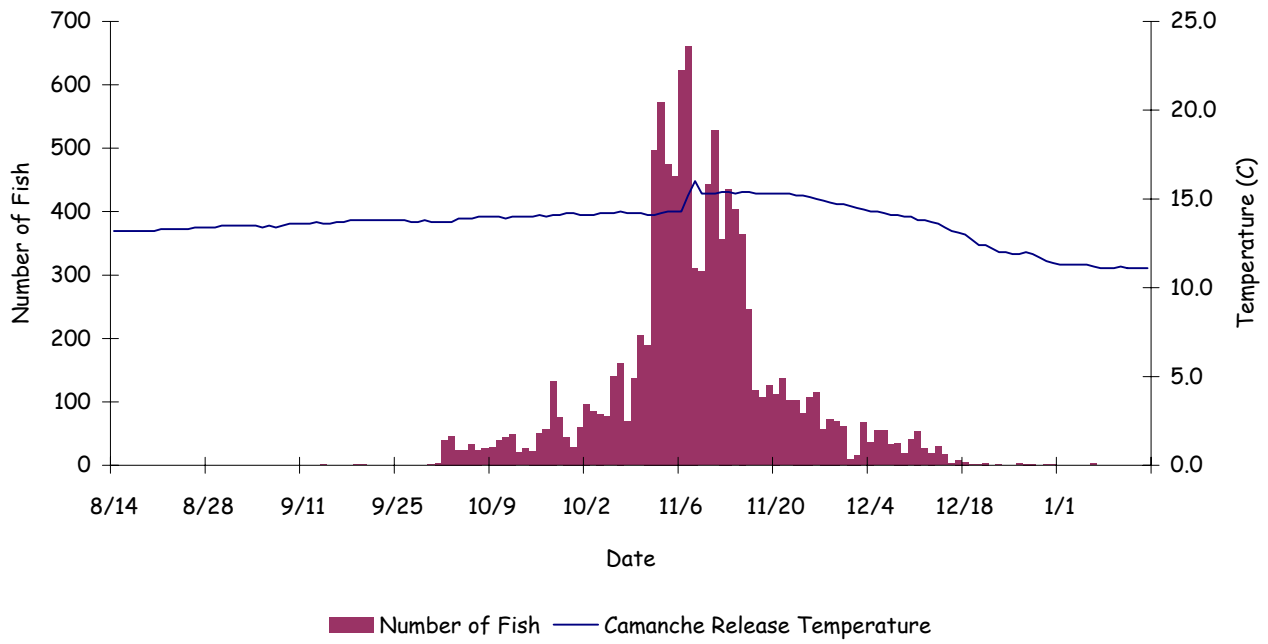


Figure 5b. Daily abundance of Chinook salmon passing Woodbridge Irrigation District Dam and temperature, August 14, 2002-January 14, 2003.

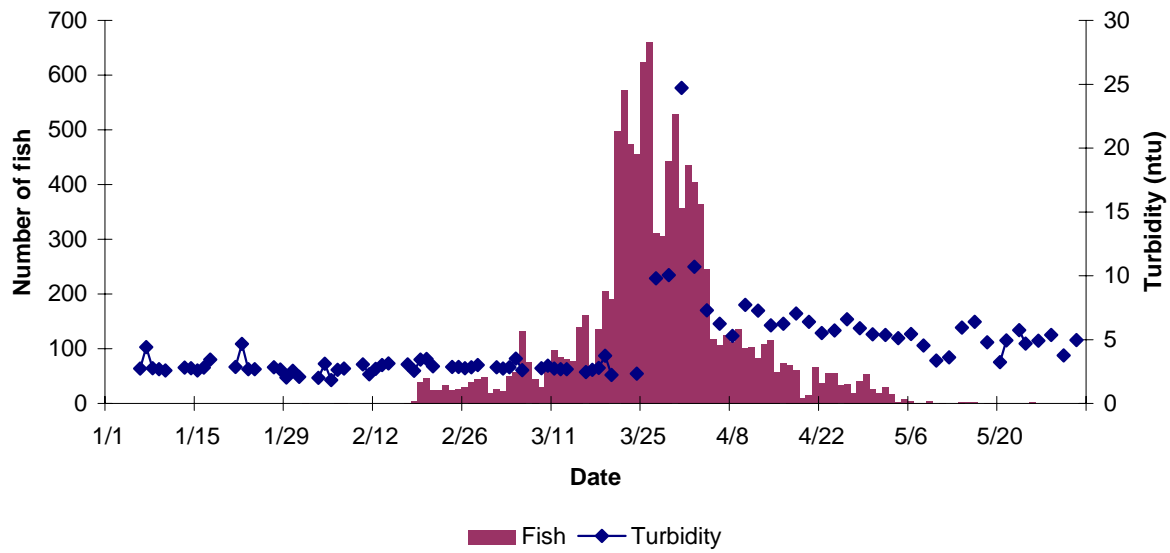


Figure 5c. Daily abundance of Chinook salmon passing Woodbridge Irrigation District Dam and turbidity, August 14, 2002-January 14, 2003.

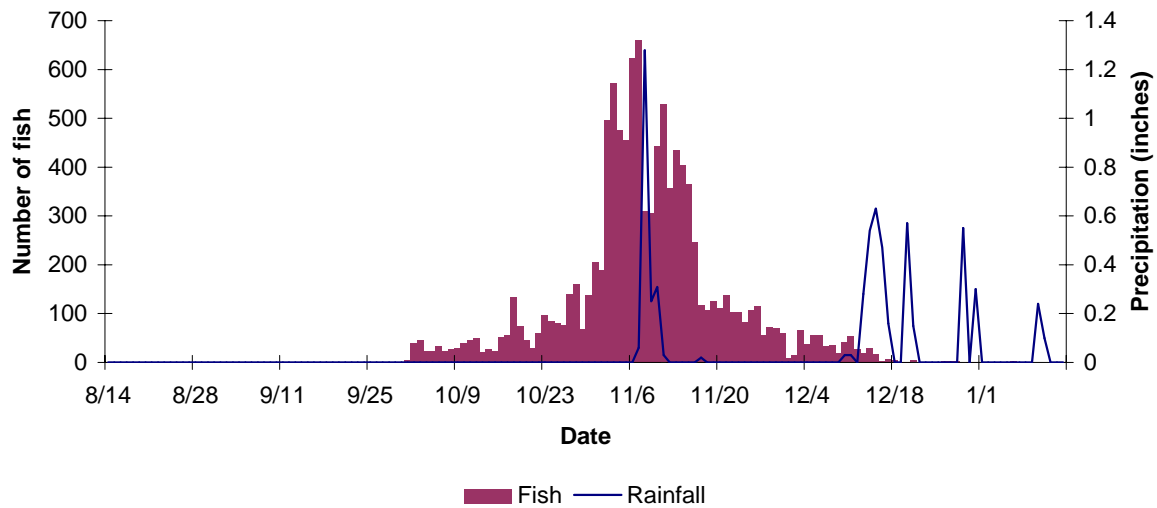


Figure 5d. Daily abundance of Chinook salmon passing Woodbridge Irrigation District Dam and precipitation, August 14, 2002-January 14, 2003.

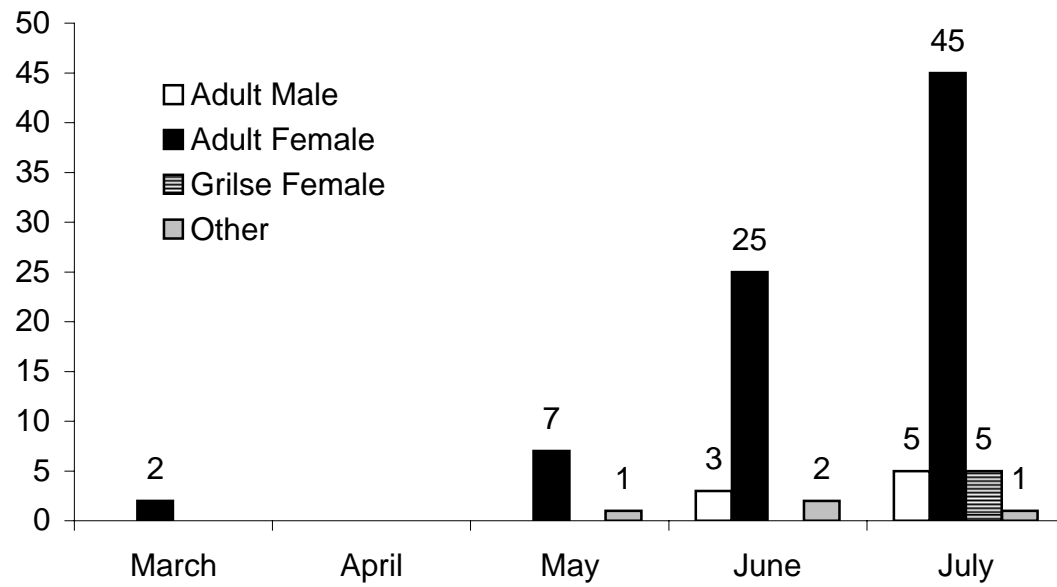


Figure 6. Chinook salmon passing Woodbridge Irrigation District Dam from March 8, 2003 -July 31, 2003 (Data in Appendix A).

Highest monthly abundance of steelhead was in January (32)(Figure 7). This coincides with historic periods of peak migration on some Sacramento River tributaries (Hallock 1989).

Yearling steelhead (FL <200mm) were observed in video monitoring from December 2002 through April 2003. Subadult steelhead (FL ≤350mm) were observed in all months of monitoring, August 2002 through July 2003. Accurate counts of these fish are unattainable due to their ability to pass behind and underneath the camera.

Pacific Lamprey

Prior to the fall of 1996, adult Pacific lamprey observations at WIDD were not recorded. Numbers of adult lamprey observed during video monitoring on the LMR have been sporadic since recording began in 1996, from a high of 979 in fall 1999, to a low of one in 2000. This year 12 lamprey have passed through WID from December through July (Table 6). Lamprey in the John Day River, Oregon typically enter freshwater in the spring and overwinter in freshwater before spawning in the fall (Bayer et al 2001). Pacific lamprey may be entering the Mokelumne River in the summer to spawn in the fall. Pacific lamprey are in decline in the Columbia and Snake River Basins and the same may be true in the Central Valley (Close et al 1995; Brown and Moyle 1993).

This year telemetry tags were placed in two adult lamprey caught in rotary screw traps below WIDD to assess upstream movement and holding patterns and to attempt to locate spawning areas for Pacific lamprey on the LMR. Fish were tagged using the “Lamprey Radio-Tagging Procedure” from the Columbia River Research Lab in Cook, Washington (Bayer et al 2001). The first fish tagged was a male (593mm) that was tagged on December 18th at WIDD, placed upstream of the dam and tracked throughout the life of the battery, to the end of May. The second fish tagged was a gravid female (439mm) tagged in March and placed above WIDD. Initial movement of this fish was in a downstream direction, and then no movement was detected for the duration of the life of the tag. It is assumed that this fish did not survive the tag implant surgery, or shed the tag, which drifted downstream.

The male lamprey was located 88 times over the 23 week period from 12/19/03 and 5/28/03. Upstream movement distances ranged from 6.8 m to 4758 m between monitoring periods. Total distance moved upstream was 8367m over a 161 day period, for a rate of 52 m/day. Movement was sporadic with extended holding periods intermixed with movement. Holding times varied from 4 days to 58 days, with the longer periods occurring furthest upstream and later in the tracking period. Holding areas were characterized by depths greater than 2.5ft (0.76 m), silt substrate, low velocities and woody debris in the form of root wads, snags and/or submerged trees. Study of upstream migrating sea lamprey show they are almost always located in areas with reduced light, within debris piles, and under undercut banks (Kelso and Gardner 2000). This is similar to the pattern we saw here. More research is needed to assess spawning timing, location, and habitat for Pacific lamprey on the Mokelumne River.

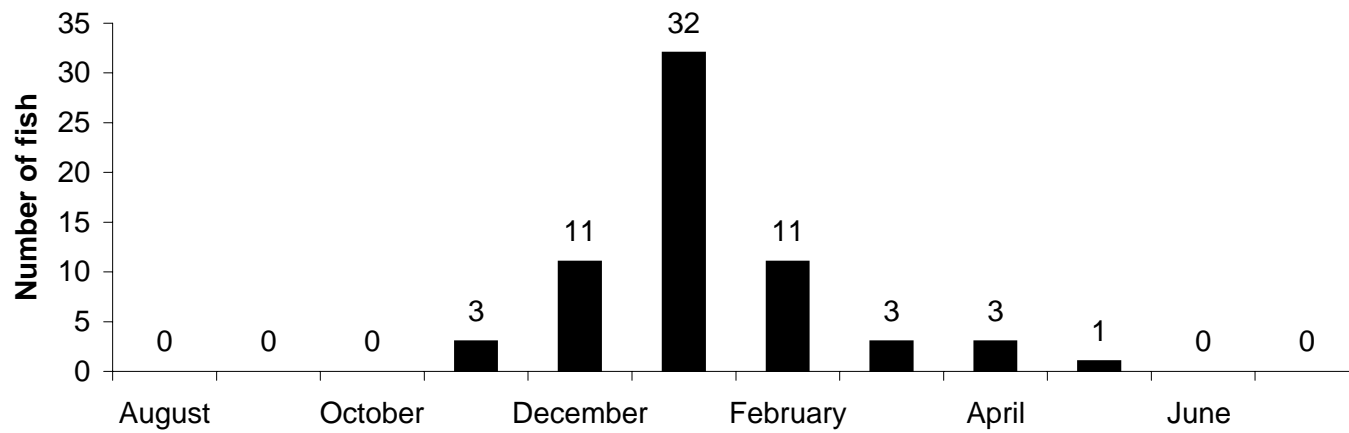


Figure 7. Monthly upstream passage of adult steelhead at Woodbridge Irrigation District Dam, August 14, 2002 - July 31, 2003.

Table 6. Adult Pacific lamprey observed moving upstream during video monitoring at Woodbridge Irrigation District Dam, 1996-2001.

Year	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1996	n/a	123	13	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1997	n/a	12	7	n/a	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1998	14	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a
1999	323	606	50	0	0	0	0	0	n/a	n/a	n/a	n/a
2000	1	0	0	0	0	0	0	0	0	n/a	n/a	n/a
2001	0	0	0	0	0	0	0	0	0	0	2	2
2002	0	0	0	0	1	0	0	2	0	0	0	0
2003	0	0	0	0	1	0	1	1	0	2	0	7

Chum Salmon

This monitoring season two female chum salmon, *O. keta*, were passed through the ladder trap, one on 11/7/02 (650 mm) and the other on 12/6/02 (750mm). Last year was the first year with a verified record of chum salmon in the Mokelumne River. During 2001/2002 monitoring we passed one male and one female through the ladder trap at WIDD. Chum salmon have the widest natural geographic distribution of all of the Pacific salmon. Hallock and Fry (1967) reported spawning populations on the Sacramento River, but they only occur occasionally in Northern California (Salo 1991).

Native Resident Fish

Native resident fishes observed using the ladder include Sacramento pikeminnow, Sacramento sucker, Sacramento blackfish, and tule perch (Table 7).

Sacramento pikeminnow were observed in all months except January and February. Peak abundance occurred in April and May. Moyle (2002) states ripe pikeminnow usually move upstream to spawn in April and May. A large number of pikeminnow were observed moving downstream in June.

Table 7. Native and non-native resident fish observed in the Woodbridge Irrigation District Dam fish ladders, Aug 01, 2002-July 31, 2003*.

<i>Species</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>April</i>	<i>May</i>	<i>June</i>	<i>July</i>
American Shad	1										3	
Black bass									5	13	7	2
Common carp	-1									31	3	
Channel catfish										3		
Goldfish			1			-1						
Sacramento blackfish										1		
Sacramento pikeminnow	46	26	9	1	1			21	98	93	-94	14
Sacramento sucker	2	4	4	1		1	15	98	24	18	16	49
Tule perch	-3		-2				1	-1			-2	

* native species appear in bold print.

** negative numbers indicate net downstream movement

Sacramento suckers typically congregate and begin moving toward spawning areas from February to June with peak activity in March and April (Moyle2002). Sacramento suckers were observed every month except December, with peak abundance occurring in April.

Tule perch were observed sporadically, mainly as downstream movements through the ladder. Tule perch have been observed both above and below WID fishladders during fish community surveys (EBMUD unpublished data). Tule perch are small enough to navigate the ladders through the drain holes at the base of each weir, and may use these to pass upstream unobserved.

One Sacramento blackfish was observed in May. These fish are uncommon in fish community surveys on the LMR, and all observations have been below WID.

Non-native Resident Fish

Non-native resident fish using the fish ladders at WIDD include black bass, common carp, channel catfish, and goldfish.

Non-native Anadromous Fish

Only one species of non-native anadromous fish, American shad, was observed using the ladders at WIDD. American shad were observed in August of 2002 and again in June of 2003. American shad are native to the Atlantic coast and were introduced into the Sacramento River in the 1870s as a sport fish (Moyle 2002). Adults on the Mokelumne River have been observed in May through August in the basin below WIDD during fish community surveys. No American shad have been observed above WIDD during fish community surveys (EBMUD unpub. data).

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Appendix A. Daily passage of Chinook and steelhead at Woodbridge Dam.

August 14, 2002-July 31, 2003.

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
8/14/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/15/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/16/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/17/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/18/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/19/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/20/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/22/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/23/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/24/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/25/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/27/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/29/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/30/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/31/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/1/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/2/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/3/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/4/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/6/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/7/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/8/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/9/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/11/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/12/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/13/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/14/2002	0	0	0	0	1	0	0	0	0	1	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
9/15/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/16/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/17/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
9/20/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
9/21/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/22/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/23/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/24/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/25/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/26/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/27/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/28/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/29/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/30/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
10/1/2002	1	2	0	1	0	0	0	0	0	4	0	0	0	0
10/2/2002	5	21	1	4	9	0	0	0	0	40	0	0	0	0
10/3/2002	12	19	0	9	6	0	0	0	0	46	0	0	0	0
10/4/2002	3	9	0	8	4	0	0	0	0	24	0	0	0	0
10/5/2002	4	4	0	10	6	0	0	0	0	24	0	0	0	0
10/6/2002	3	11	0	7	13	0	0	0	0	34	0	0	0	0
10/7/2002	4	11	0	3	6	0	0	0	0	24	0	0	0	0
10/8/2002	11	14	0	1	1	0	0	0	0	27	0	0	0	0
10/9/2002	9	12	0	4	3	1	0	0	0	29	0	0	0	0
10/10/2002	15	13	0	9	2	1	0	0	0	40	0	0	0	0
10/11/2002	13	17	0	6	7	2	0	0	0	45	0	0	0	0
10/12/2002	9	20	0	11	6	3	0	0	0	49	0	0	0	0
10/13/2002	8	7	0	4	1	0	0	0	0	20	0	0	0	0
10/14/2002	7	12	0	5	3	0	0	0	0	27	0	0	0	0
10/15/2002	5	12	0	5	0	0	0	0	0	22	0	0	0	0
10/16/2002	13	15	0	17	5	1	0	0	0	51	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
10/17/2002	14	17	0	18	8	0	0	0	0	57	0	0	0	0
10/18/2002	51	51	0	22	9	0	0	0	0	133	0	0	0	0
10/19/2002	27	21	0	19	7	1	0	0	0	75	0	0	0	0
10/20/2002	16	9	0	16	4	0	0	0	0	45	0	0	0	0
10/21/2002	11	7	0	7	4	0	0	0	0	29	0	0	0	0
10/22/2002	24	20	0	12	4	0	0	0	0	60	0	0	0	0
10/23/2002	38	26	0	17	16	0	0	0	0	97	0	0	0	0
10/24/2002	34	26	0	17	7	1	0	0	0	85	0	0	0	0
10/25/2002	38	18	0	17	7	1	0	0	0	81	0	0	0	0
10/26/2002	38	16	0	18	4	0	0	0	1	77	0	0	0	0
10/27/2002	47	32	0	53	8	0	0	0	0	140	0	0	0	0
10/28/2002	62	50	0	35	15	0	0	0	-1	161	0	0	0	0
10/29/2002	32	22	1	9	4	1	0	0	0	69	0	0	0	0
10/30/2002	53	37	0	31	13	2	0	0	1	137	0	0	0	0
10/31/2002	77	71	0	41	13	3	0	0	0	205	0	0	0	0
11/1/2002	82	39	0	53	16	0	0	0	0	190	0	0	0	0
11/2/2002	202	130	-1	128	30	9	0	0	-1	497	0	0	0	0
11/3/2002	180	180	0	166	36	11	0	0	0	573	0	0	0	0
11/4/2002	194	157	1	93	27	2	0	0	1	475	0	0	0	0
11/5/2002	214	170	0	61	11	0	0	0	0	456	0	0	0	0
11/6/2002	280	246	0	79	19	0	0	0	0	624	0	0	0	0
11/7/2002	349	275	0	27	10	0	0	0	0	661	0	0	0	0
11/8/2002	149	106	0	51	5	0	0	0	0	311	1	0	0	1
11/9/2002	129	146	0	22	9	0	0	0	0	306	0	0	0	0
11/10/2002	169	198	0	66	10	0	0	0	0	443	0	0	0	0
11/11/2002	224	233	0	49	22	0	0	0	0	528	1	0	0	1
11/12/2002	143	168	0	39	7	0	0	0	0	357	0	0	0	0
11/13/2002	169	219	0	35	13	0	0	0	0	436	0	0	1	1
11/14/2002	151	212	0	32	9	0	0	0	0	404	0	0	0	0
11/15/2002	119	200	0	35	11	0	0	0	0	365	0	0	0	0
11/16/2002	85	131	0	22	8	0	0	0	0	246	0	0	0	0
11/17/2002	48	48	0	15	7	0	0	0	0	118	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
11/18/2002	45	35	0	25	2	0	0	0	0	107	0	0	0	0
11/19/2002	39	64	0	21	2	0	0	0	0	126	0	0	0	0
11/20/2002	41	47	0	20	4	0	0	0	0	112	0	0	0	0
11/21/2002	56	66	0	12	3	0	0	0	0	137	0	0	0	0
11/22/2002	28	45	0	20	9	0	0	0	0	102	0	0	0	0
11/23/2002	35	38	0	24	6	0	0	0	0	103	0	0	0	0
11/24/2002	32	26	0	19	6	0	0	0	0	83	0	0	0	0
11/25/2002	49	45	0	9	5	0	0	0	0	108	0	0	0	0
11/26/2002	38	46	0	25	6	0	0	0	0	115	0	0	0	0
11/27/2002	21	25	0	8	3	0	0	0	0	57	0	0	0	0
11/28/2002	28	26	0	16	3	0	0	0	0	73	0	0	0	0
11/29/2002	32	26	0	10	2	0	0	0	0	70	0	0	0	0
11/30/2002	30	24	0	7	0	0	0	0	0	61	0	0	0	0
12/1/2002	5	5	0	0	0	0	0	0	0	10	0	0	0	0
12/2/2002	11	5	0	0	0	0	0	0	0	16	0	0	0	0
12/3/2002	24	33	0	8	2	0	0	0	0	67	0	0	1	1
12/4/2002	11	14	0	9	3	0	0	0	0	37	0	0	0	0
12/5/2002	18	26	0	7	4	0	0	0	0	55	0	0	0	0
12/6/2002	15	28	0	10	2	0	0	0	0	55	0	0	0	0
12/7/2002	15	12	0	5	1	0	0	0	0	33	0	0	0	0
12/8/2002	11	20	0	3	1	0	0	0	0	35	0	0	0	0
12/9/2002	5	13	0	1	0	0	0	0	0	19	0	0	0	0
12/10/2002	13	24	0	2	2	0	0	0	0	41	0	0	0	0
12/11/2002	14	32	0	5	3	0	0	0	0	54	0	1	0	1
12/12/2002	8	17	0	0	2	0	0	0	0	27	0	0	0	0
12/13/2002	8	11	0	0	0	0	0	0	0	19	0	0	0	0
12/14/2002	11	16	0	1	2	0	0	0	0	30	0	1	0	1
12/15/2002	3	12	0	1	1	0	0	0	0	17	0	0	0	0
12/16/2002	1	0	0	2	0	0	0	0	0	3	0	1	0	1
12/17/2002	1	4	0	3	0	0	0	0	0	8	0	0	0	0
12/18/2002	2	3	0	0	0	0	0	0	0	5	0	0	0	0
12/19/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
12/20/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
12/21/2002	2	2	0	0	0	0	0	0	0	4	0	0	0	0
12/22/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/23/2002	0	0	0	0	1	0	0	0	0	1	1	1	0	2
12/24/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/25/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/26/2002	2	0	0	1	0	0	0	0	0	3	2	0	0	2
12/27/2002	2	0	0	0	0	0	0	0	0	2	0	0	1	1
12/28/2002	2	0	0	0	0	0	0	0	0	2	0	-1	0	-1
12/29/2002	0	0	0	0	0	0	0	0	0	0	1	0	0	1
12/30/2002	1	0	0	0	0	0	0	0	0	1	0	1	0	1
12/31/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
1/1/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/3/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/4/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/5/2003	0	0	0	0	0	0	0	0	0	0	1	0	0	1
1/6/2003	0	0	0	3	0	0	0	0	0	3	0	0	0	0
1/7/2003	0	0	0	0	0	0	0	0	0	0	1	0	0	1
1/8/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/9/2003	0	0	0	0	0	0	0	0	0	0	1	1	0	2
1/10/2003	0	0	0	0	0	0	0	0	0	0	3	0	1	4
1/11/2003	0	0	0	0	0	0	0	0	0	0	0	1	0	1
1/12/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/13/2003	0	0	0	0	0	0	0	0	0	0	2	0	0	2
1/14/2003	0	0	0	0	0	0	0	0	0	0	2	1	0	3
1/15/2003	0	0	0	0	0	0	0	0	0	0	1	-1	0	0
1/16/2003	0	0	0	0	0	0	0	0	0	0	2	0	0	2
1/17/2003	0	0	0	0	0	0	0	0	0	0	0	1	0	1
1/18/2003	0	0	0	0	0	0	0	0	0	0	2	0	0	2
1/19/2003	0	0	0	0	0	0	0	0	0	0	0	2	0	2
1/20/2003	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
7/2/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
7/4/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/5/2003	0	0	0	0	1	0	0	0	0	1	0	0	0	0
7/6/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/7/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10/2003	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1
7/11/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/12/2003	0	0	1	0	0	0	0	0	0	1	0	0	-1	-1
7/13/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
7/14/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/15/2003	0	1	0	0	1	1	0	0	0	3	0	0	-1	-1
7/16/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/17/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/18/2003	0	0	0	0	1	0	0	0	0	1	0	0	0	0
7/19/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/20/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/21/2003	0	1	0	0	0	0	0	0	0	1	0	0	1	1
7/22/2003	0	6	0	0	2	0	0	0	0	8	0	0	0	0
7/23/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
7/24/2003	1	3	0	0	0	0	0	0	0	4	0	0	-1	-1
7/25/2003	1	4	0	0	0	0	0	0	0	5	0	0	0	0
7/26/2003	0	5	0	0	0	0	0	0	0	5	0	0	-1	-1
7/27/2003	1	3	1	0	0	0	0	0	0	5	0	0	0	0
7/28/2003	1	2	0	0	0	0	0	0	0	3	0	0	-1	-1
7/29/2003	1	5	0	0	0	0	0	0	0	6	0	0	0	0
7/30/2003	0	2	0	0	0	0	0	0	0	2	0	0	-1	-1
7/31/2003	0	1	0	0	0	0	0	0	0	1	0	0	-1	-1
Totals	4,243	4,350	7	1,686	526	40	0	0	1	10,853	25	19	9	53

* -1 values indicate a net downstream migration for the day in question