

**LOWER MOKELUMNE RIVER
UPSTREAM FISH MIGRATION MONITORING
Conducted at Woodbridge Irrigation District Dam
August 2001 through March 2002**

August 2002

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Key words: lower Mokelumne River, chinook salmon, steelhead, escapement

Abstract: This report documents monitoring data collected below Woodbridge Irrigation District Dam (WIDD) on the lower Mokelumne River (LMR) from August 13, 2001 through March 31, 2002. An estimated 8,114 chinook salmon (*Oncorhynchus tshawytscha*) passed the Woodbridge Irrigation District Dam fish ladders between September 27, 2001 and February 18, 2002. Fifty percent of the run passed WIDD by November 11, 2001 as compared to October 30 of last year. Highest daily passage was 594 on November 14, 2001. The size class and sex was positively determined for 4,782 salmon and included 1,952 (41%) females > 60 cm FL, 1,852 (39%) males >60 cm FL, 389 (8%) females ≤ 60 cm FL and 589 (12%) males ≤ 60 cm FL. An estimate of 2,932 fish was added to count data, in response to trap failure, based on the methods described below. Ninety-one adult steelhead (*O. mykiss*) passed WIDD between November 18, 2001 and March 31, 2002. Peaks in steelhead passage occurred in December, January and February. Other species using the WIDD fishways included: chum salmon, *O. keta*; largemouth bass, *Micropterus salmoides*; Sacramento pikeminnow, *Ptychocheilus grandis*; Sacramento sucker, *Catostomus occidentalis*; Sacramento splittail, *Pogonichthys macrolepidotus*; smallmouth bass, *Micropterus dolomieu*; and threadfin shad, *Dorosoma petenense*.

INTRODUCTION

East Bay Municipal Utility District (EBMUD) has been monitoring 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 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.

OBJECTIVES

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

METHODS

EBMUD's monitoring of chinook salmon migration began on August 13, 2001 with video monitoring in the high stage ladder at the WIDD. On November 6, 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 7th. This continued until December 7, 2001, when video monitoring only resumed in the low-stage ladder. Video monitoring in the low stage ladder continued to March 15, 2002. Monitoring in the high stage was resumed on March 17, 2002, when the boards of WID were installed, and continued through March 31, 2002. Accurate counts of salmon passing upstream in the ladder were hampered by poor visibility and malfunctions in the ladder trap. This was made evident by the cumulative counts at the Mokelumne River Fish Hatchery (MRFH) exceeding the observations at WIDD. To provide an estimate of the salmon passing the WIDD, EBMUD used 1) known ratios of the number of fish counted at the MRFH and observations at WIDD prior to operation of the low-stage ladder and trap; 2) counts at MRFH in 2001/02; and, 3) observations at WIDD in 2001. The results were compared to escapement data from 2000/01 for verification of the methodology.

1. MRFH/WID COUNT RATIO

The ratio of the cumulative total count of salmon in the MRFH on November 5, 2001, prior to operation of the low-stage ladder, and the cumulative total count of salmon observed at WIDD on November 5, 2001 was calculated (0.607985). The ratio of the cumulative total count of salmon in the MRFH on December 1, 2000 and the cumulative total count of salmon observed at WIDD on December 1, 2000 was calculated (0.747812). It is assumed that the December 1, 2001 ratio of MRFH to WIDD cumulative counts is similar to the ratio on December 1, 2000. The daily ratio of MRFH/WIDD for the period November 5, 2001 through December 1, 2001 was interpolated assuming a linear relationship and remained at 0.747812 from December 1 through December 7, 2001. This provided daily estimates of the MRFH/WIDD ratios for the period November 5 through December 7, 2001.

2. MRFH COUNTS

Total counts of salmon at MRFH were conducted on November 5, 8-9, 12-16, 19, 21, 26, 29-30 and December 3,7, 2001. Daily estimates of the cumulative count between these dates were interpolated assuming a linear relationship between count dates. This provided daily estimates of the total number of salmon counted or expected at MRFH from November 5 through December 7, 2001.

3. WID ESTIMATE

The daily cumulative estimate of salmon at the MRFH divided by the daily ratio of MRFH/WIDD counts generated an estimate of cumulative counts at WIDD for the period November 5 through December 7, 2001. This daily estimate was adjusted based on the actual number observed at the ladder, with the final estimate being the greater of the calculated daily estimate or the actual number of fish observed at WIDD.

For example, on November 10, 2001, the cumulative number of salmon observed at WIDD was 3,070. The calculated estimate based on estimated cumulative count at MRFH (2,395) and the expected daily ratio of MRFH/WIDD counts (0.634874) was 3,772 (2,395/0.634874). On November 20, 2001, the cumulative number of salmon observed at WIDD was 3,847. The calculated estimate based on the estimated cumulative count at MRFH (4,637) and the expected daily ratio of MRFH/WIDD counts (0.688654) was 6,733, an increase of 45 fish from November 19, 2001. This estimate was revised to 6,778 based on the number of salmon actually observed at WIDD on November 20, 2001 (90) yielding an estimate of 6,778.

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 chinook salmon escapement estimate in the LMR for 2001/2002 is 8,114 spawners entering the river between September 27, 2001 and February 18, 2002 (Figure 1). Fifty percent of the run passed WIDD by November 11, 2001 as compared to October 30 of last year (Table 1). Highest daily passage based on estimates was 594 on November 14, 2001. The sex and life stage was positively determined for 4,782 salmon and included 1,952 (41%) adult (> 60 cm FL) females, 1,852 (39%) adult males, 389 (8%) grilse (≤ 60 cm FL) females and 589 (12%) grilse males. An estimate of 2,932 fish was added to count data, in response to trap failure, based on the methods described above (Figure 2). Data are in Appendix A.

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

<u>Year</u>	<u>50% Date</u>	<u>Year</u>	<u>50% Date</u>	<u>Year</u>	<u>50% Date</u>
<u>1990</u>	Nov. 18	<u>1994</u>	Nov. 7	<u>1998</u>	Nov. 4
<u>1991</u>	n/a	<u>1995</u>	Oct. 30	<u>1999</u>	Nov. 3
<u>1992</u>	Nov. 13	<u>1996</u>	Oct. 31	<u>2000</u>	Oct. 30
<u>1993</u>	Nov. 3	<u>1997</u>	Nov. 8	<u>2001</u>	Nov. 11

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

In the 2001/2002 monitoring season, 58% of fish passage by the video monitor occurred during the day, and 42% during the night. Daytime passage has been consistently higher than nighttime passage (Table 2). Last year, passage was crepuscular, with peaks between 08:00-10:00 and 16:00-18:00 (Workman 2001). This year the same pattern is not evident. There is an early morning peak, but not a corresponding late afternoon peak (Figure 3).

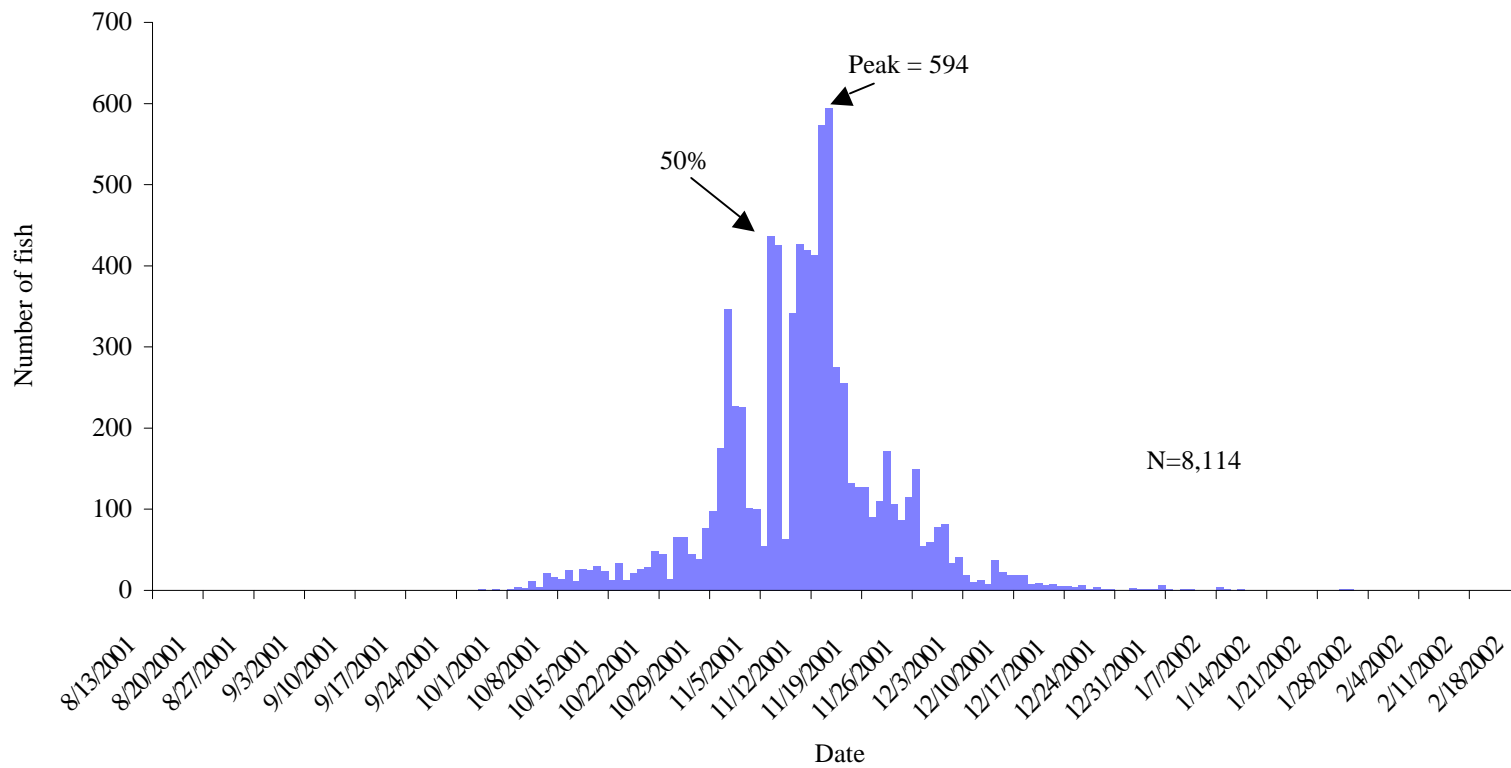


Figure 1. Daily abundance and timing of chinook salmon migrating past Woodbridge Irrigation District Dam, August 13, 2001 - March 31, 2002. (Data in Appendix A.)

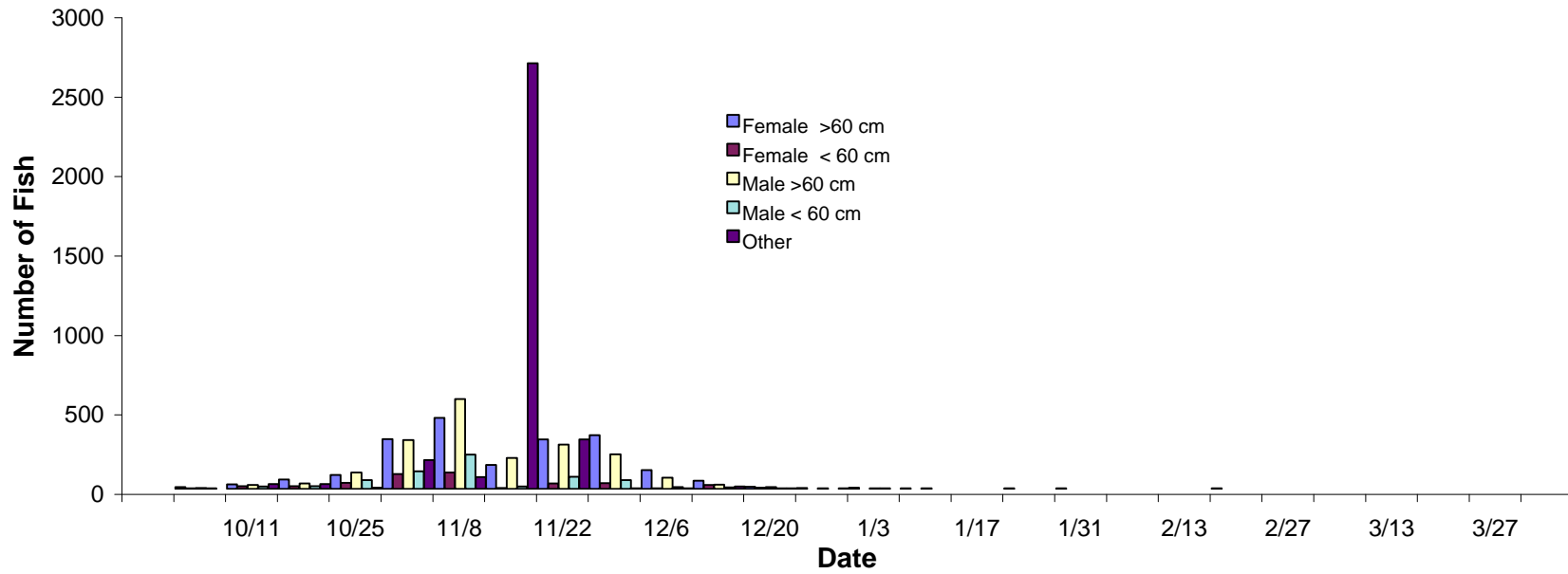


Figure 2. Weekly sex/size composition of chinook salmon passing Woodbridge Irrigation District Dam, August 13, 2001 -March 31, 2002. (data in Appendix A.)

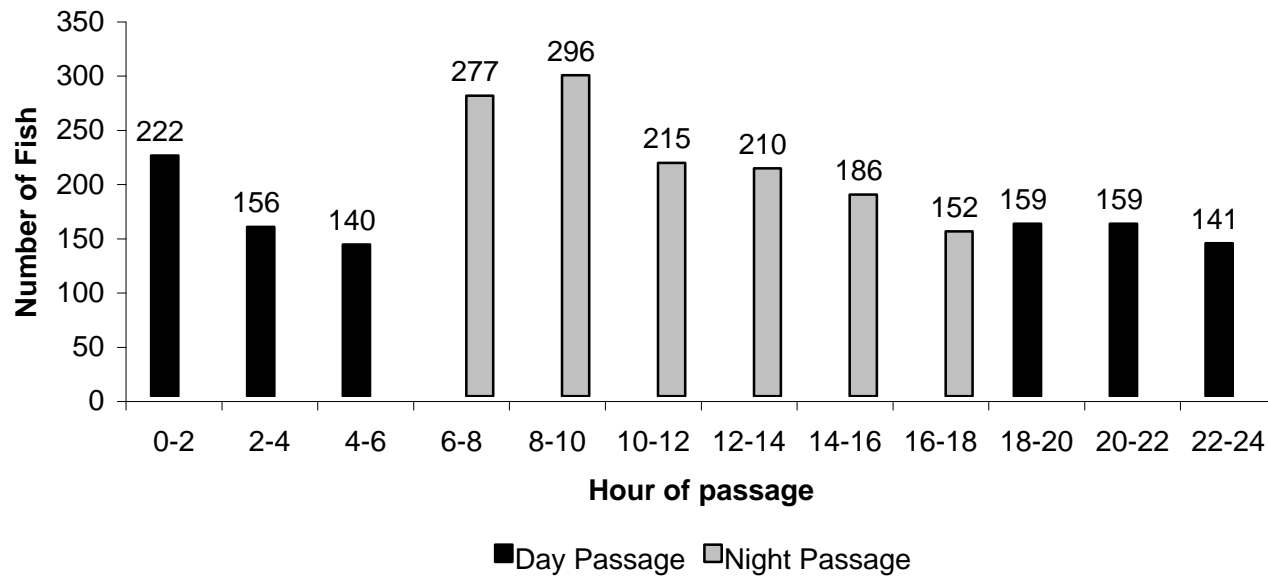


Figure 3. Chinook salmon passage (2 hour intervals) recorded from video monitoring at the Woodbridge Irrigation District Dam, August 13, 2001-March 31, 2002.

**Table 2. Percent of annual 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>
Day	57	64	69	59	61	68	52	56	56	62	68	58
Night	43	36	31	41	39	32	48	44	44	38	32	42

Clipped adipose fins were evident on 514 (10%) of the observed chinook salmon. Of the identifiable grilse and adults 18.6% (188), and 8.5% (326), respectively, had adipose fin clips. The percentage of adipose clipped adults has ranged from 0.9% in 1993 to a high of 10.8% in 1999. The range for grilse has been from 1.7% in 1993 and 1997 to a high of 18.6% this season (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 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 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
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	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	160	7
2000/2001	83	8	7	0.5	71	5.5
2001/2002	188	18.6	3	0.3	58	5.8

Free passage during drawdown activities has been observed in previous years. Last year no free spill passage was observed. This year 2 salmon were observed passing through bay 1 of the dam during drawdown activities. Although the number is small, it contributes to the total escapement and should not be overlooked as a passage route.

The number of chinook salmon observed at WIDD was 5,183. An estimate of 8,114 was developed, an increase of 2,932 over the observations at WIDD. Specifically, the calculated estimate altered the daily counts on following dates (Table 4).

Table 4. Observations and Estimates of chinook salmon passage at WIDD during low-stage ladder trapping.

<i>DATE</i>	<i>OBSERVED AT WIDD</i>	<i>ESTIMATED AT WIDD</i>	<i>DIFFERENCE</i>
11/9	32	342	310
11/10	34	427	393
11/11	70	420	350
11/12	72	413	341
11/13	131	573	442
11/14	42	594	552
11/15	41	275	234
11/16	70	256	186
11/18	88	127	39
11/19	41	126	85

During the 2000/2001 chinook salmon migration, 7,418 salmon were observed at WIDD and 5,524 salmon were collected at MRFH, a ratio of 0.74 (MRFH cumulative count/WIDD cumulative count). During the 2001/02 migration, an estimated 8,114 passed WIDD and 5,809 salmon were collected at MRFH, a ratio of 0.72. The number of redds observed in the lower Mokelumne River during the 2000/01 spawning period was 987 and the number observed in 2001/02 was 846. The 2000/01 ratio of adults in the river (WIDD observations minus the MRFH count) to redds was 1.6. The 2001/02 ratio of adults in the river (WIDD estimate using the MRFH adult/grilse ratio minus the MRFH count) to redds was 1.3. These data appear to be consistent and represent the best estimate of fall-run chinook salmon escapement during the 2001/02 season.

River flow, rainfall, temperature, turbidity, and barometric pressure have been investigated for their relationship to salmon returns over the past 12 years. Correlation analysis for these factors did not show any significant relationship during the 2001/2002 migration period. All regression coefficients of the environmental variable to the number of fish observed by date at WIDD appear in parenthesis following the variable description.

For the 2001/2002 migration period Camanche Dam releases ranged from 186-471 cfs (57-144 m³/s). Average flow was 262 cfs (80 m³/s) (R²= .009)(Figure 4a). Flows below WID ranged from 30-487 cfs (9-148 m³/s) and averaged 156 cfs (48 m³/s)(R²= .037). Temperatures for the August through May monitoring period ranged from 48.7°-60.1°F (9.3-15.6°C) at Camanche Dam (R²= .18) and 45.3-72.9°F (7.4°-22.7°C) at WIDD(R²= .03) (Figure 4b). Barometric pressure ranged from 29.59-30.37 inches of Hg (75.15-77.14 cm Hg) (R²= .0001) (Figure 4c). Turbidity increases in the LMR with rainfall. Total rainfall for the survey period was 11.40 inches (28.9 cm). Peak daily rainfall was 0.96 inches (2.43 cm)(R²= .004). Turbidity ranged from 2.15 to 18.15 ntu (R²= .12) (Figures 4d and 4e).

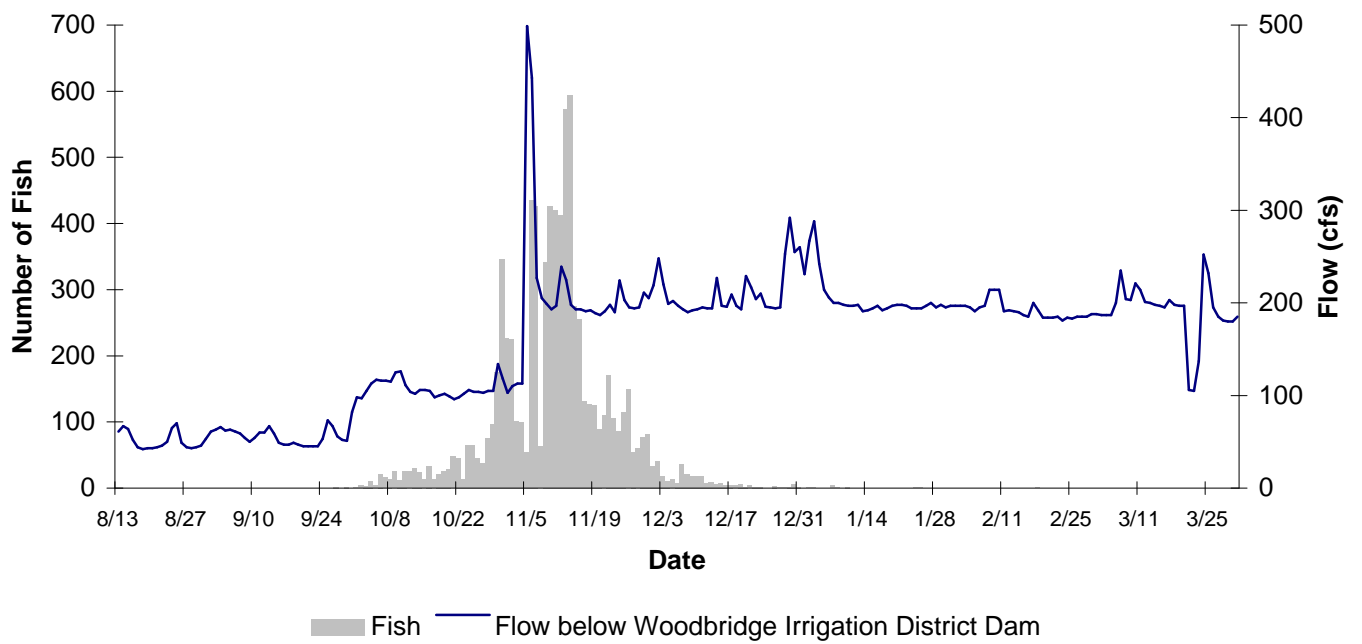
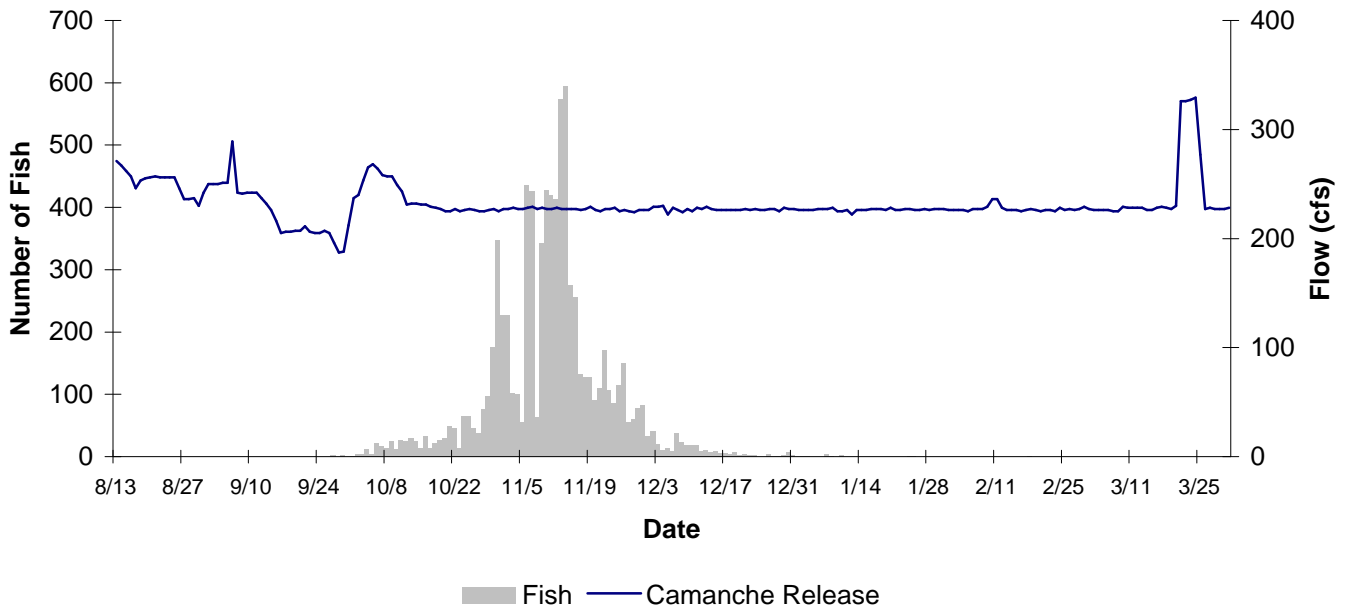


Figure 4a. Daily abundance of chinook salmon passing Woobridge Irrigation District Dam and flow, August 13, 2001 - March 31, 2002.

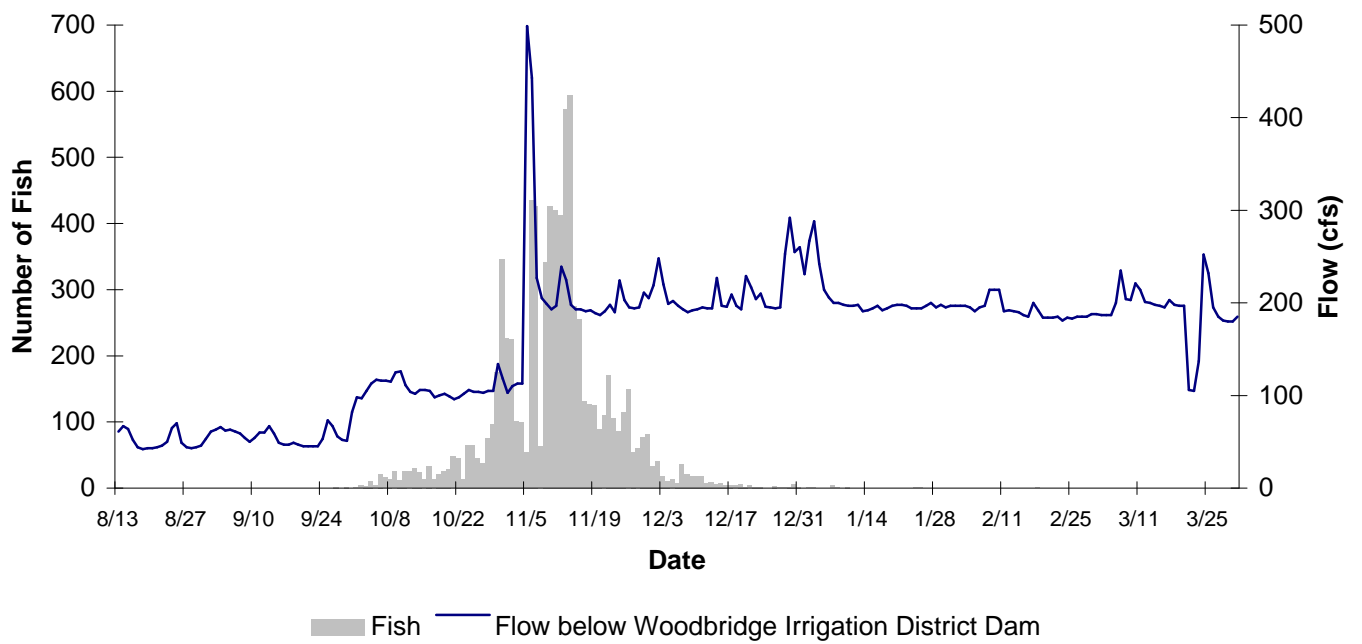
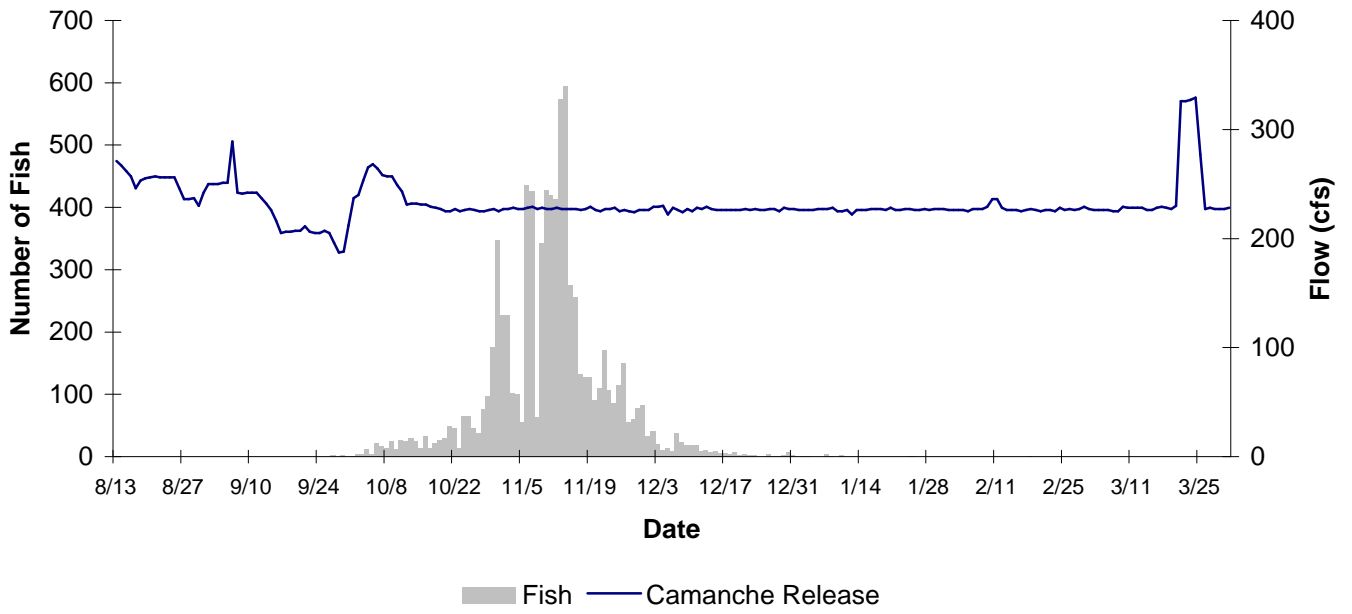


Figure 4a. Daily abundance of chinook salmon passing Woobridge Irrigation District Dam and flow, August 13, 2001 - March 31, 2002.

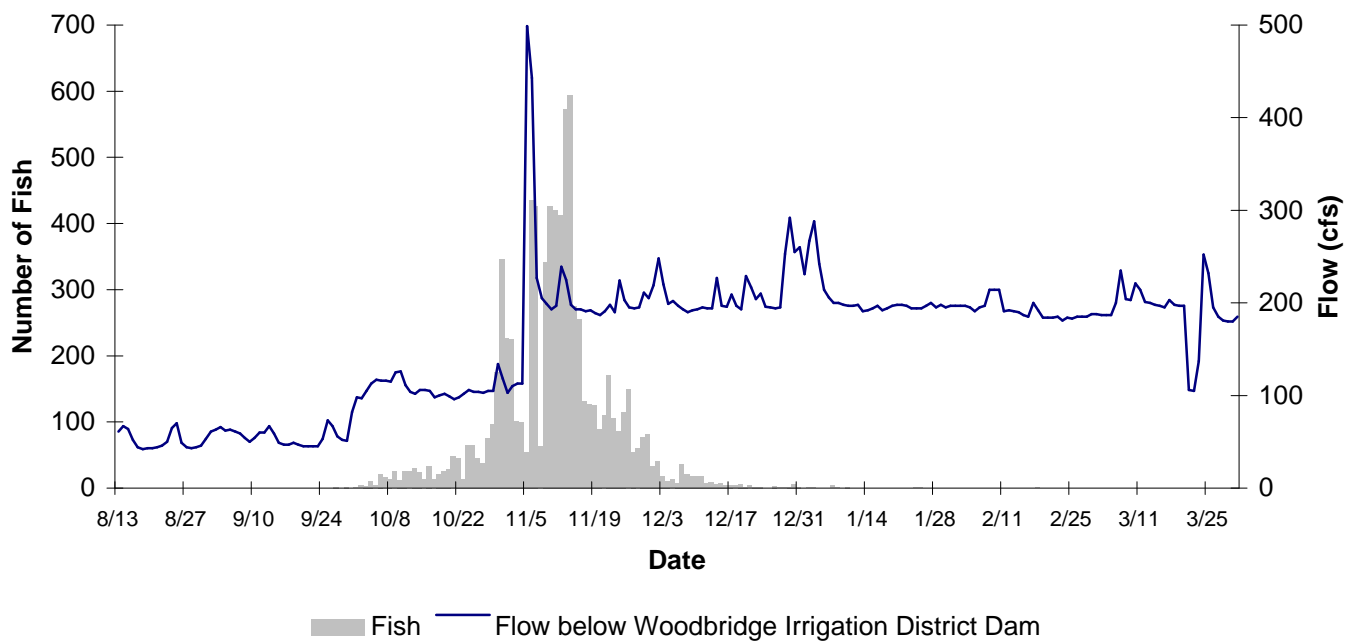
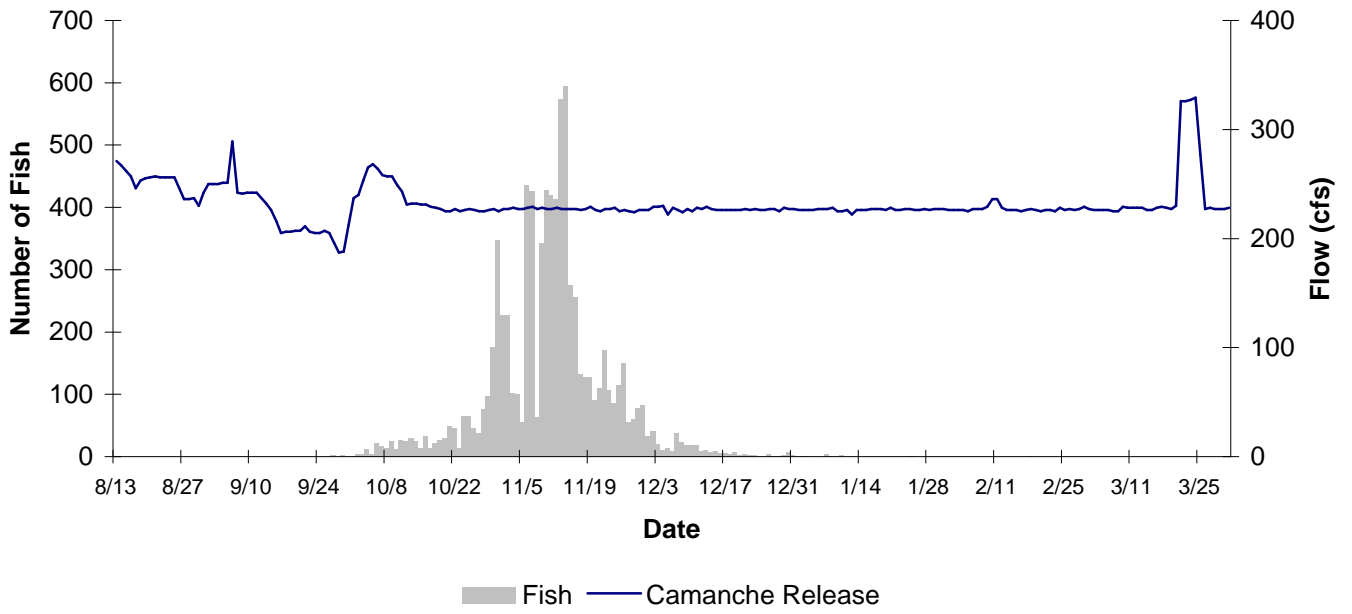


Figure 4a. Daily abundance of chinook salmon passing Woobridge Irrigation District Dam and flow, August 13, 2001 - March 31, 2002.

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>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>
1990/91	4	1996/97	12
1991/92	n/a	1997/98	6
1992/93	7	1998/99	12
1993/94	8	1999/2000	80
1994/95	19	2000/01	48
1995/96	76	2001/02	91

Ninety-one adult steelhead were observed moving upstream through WIDD from November 18, 2001 through March 31, 2002. Eighty-six were adipose-fin clipped. Of the 91 observed, 25 were males, 52 were females and 14 were not distinguishable to sex. Highest monthly abundances were in December, January and February (Figure 5). This coincides with historic periods of peak migration on some Sacramento River tributaries (Hallock 1989).

Yearling steelhead (FL <200mm) were observed in video monitoring in August of 2001. Subadult steelhead (FL ≤350mm) were observed from December through May. 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 none recorded passing upstream during video-monitoring in 2001/2002. In 1996, 1997 and 1998, less than 20 adult lamprey were observed annually in the fish ladders (Table 6). 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).

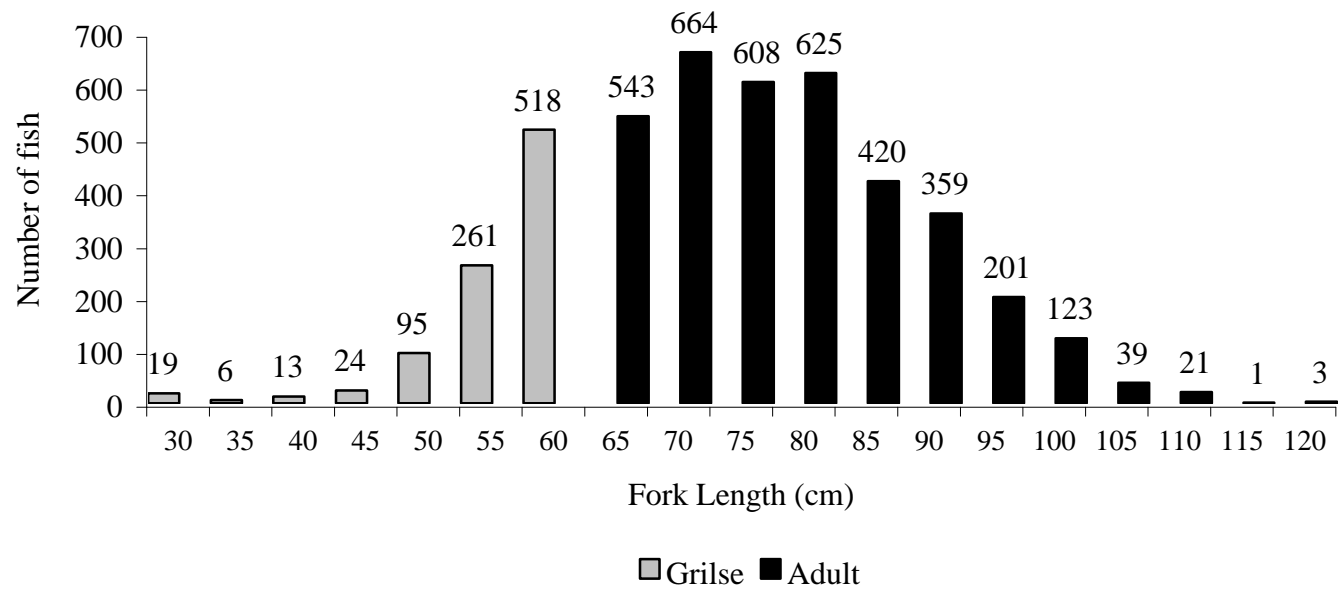


Figure 5. Length-frequency of fall-run chinook salmon passing Woodbridge Irrigation District Dam, 2001-2002.

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

<u>Year</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>
1996	n/a	123	13	0	0	n/a	n/a	n/a
1997	n/a	12	7	n/a	1	n/a	n/a	n/a
1998	14	0	0	0	0	0	0	0
1999	323	606	50	0	0	0	0	0
2000	1	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0

Chum Salmon

On 11/7/02, just after the drawdown of Lake Lodi, one 480 mm male chum salmon, *O. keta*, was trapped during monitoring and passed upstream of the ladder trap. This is the first verified record of chum salmon in the Mokelumne River. 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 splittail, and tule perch (Table 7).

Sacramento pikeminnow were observed in August and then again in March. Ripe fish usually move upstream to spawn in April and May (Moyle 2002).

Table 7. Native and non-native resident fish observed in the Woodbridge Irrigation District Dam fish ladders, Aug 13, 2001-March 31, 2002*.

<u>Species</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>
Black bass								2
Largemouth bass								4
Sacramento pikeminnow	1							17
Sacramento splittail								1
Sacramento sucker					4	4	3	117
Smallmouth bass								3
Threadfin shad								-1**
Tule perch								-1**

* 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 from December through May, with peak abundance occurring in March.

One tule perch was observed moving downstream through the ladder in March. Although tule perch are rarely seen using the ladder, tule perch have been observed in the rip-rap below the dam, and tule perch are captured in fish community surveys upstream of WID (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 splittail was observed in March. Splittail are spring spawners known to use floodplains, sloughs and streams of the delta for spawning (Caywood 1974). Preferred spawning occurs in newly inundated vegetation in slow moving water (Moyle 1976). Lake Lodi provides appropriate spawning habitat for this species. Moyle et al (1989) states that splittail are incapable of passing many existing fishways. In 2001, measured velocities in the orifice passage into lake Lodi exceeded $6.0 \text{ ft}^3/\text{sec}$ (m^3/sec). Passage criteria for Pacific northwest suckers and chubs is around $4 \text{ ft}^3/\text{sec}$ (m^3/sec) (Bell 1991) and these velocities may preclude splittail from getting into lake Lodi in any significant numbers.

Non-native Resident Fish

Non-native resident fish using the fish ladders at WIDD include largemouth bass, smallmouth bass, and threadfin shad. The bass were observed moving upstream, and the shad moving downstream

Acknowledgements

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

August 13, 2001-July 31, 2001.

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
9/14/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/15/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/16/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/17/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/20/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/21/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/22/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/23/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/24/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/25/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/26/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/27/2001	0	2	0	0	0	0	0	0	0	2	0	0	0	0
9/28/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/29/2001	2	0	0	0	0	0	0	0	0	2	0	0	0	0
9/30/2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/1/2001	0	0	0	1	0	0	0	0	0	1	0	0	0	0
10/2/2001	0	4	0	0	0	0	0	0	0	4	0	0	0	0
10/3/2001	1	2	0	0	0	0	0	0	0	3	0	0	0	0
10/4/2001	3	3	0	1	4	0	0	0	0	11	0	0	0	0
10/5/2001	1	3	0	0	0	0	0	0	0	4	0	0	0	0
10/6/2001	3	8	0	6	3	0	0	0	1	21	0	0	0	0
10/7/2001	0	0	0	0	0	0	0	0	16	16	0	0	0	0
10/8/2001	2	0	0	1	1	0	0	0	10	14	0	0	0	0
10/9/2001	8	1	0	3	12	1	0	0	0	25	0	0	0	0
10/10/2001	4	7	0	1	0	0	0	0	0	12	0	0	0	0
10/11/2001	7	10	0	5	2	-1	0	0	3	26	0	0	0	0
10/12/2001	11	6	0	5	3	0	0	0	0	25	0	0	0	0
10/13/2001	7	7	0	7	5	0	0	0	4	30	0	0	0	0
10/14/2001	0	0	0	0	0	0	0	0	24	24	0	0	0	0
10/15/2001	2	5	0	1	0	0	0	0	5	13	0	0	0	0

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

August 13, 2001-July 31, 2001.

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
10/16/2001	9	14	0	6	4	0	0	0	0	33	0	0	0	0
10/17/2001	3	14	0	-6	4	-3	0	0	1	13	0	0	0	0
10/18/2001	3	13	0	4	2	0	0	0	-1	21	0	0	0	0
10/19/2001	7	8	0	7	2	2	0	0	0	26	0	0	0	0
10/20/2001	8	8	0	5	8	0	0	0	0	29	0	0	0	0
10/21/2001	18	11	0	10	9	0	0	0	0	48	0	0	0	0
10/22/2001	21	8	0	12	4	0	0	0	0	45	0	0	0	0
10/23/2001	2	7	0	4	1	0	0	0	0	14	0	0	0	0
10/24/2001	33	16	0	2	11	2	0	0	1	65	0	0	0	0
10/25/2001	14	29	0	16	4	1	1	0	0	65	0	0	0	0
10/26/2001	16	14	0	9	6	0	0	0	0	45	0	0	0	0
10/27/2001	15	10	0	9	4	0	0	0	0	38	0	0	0	0
10/28/2001	29	26	0	14	7	0	0	0	0	76	0	0	0	0
10/29/2001	27	41	0	13	15	1	0	0	0	97	0	0	0	0
10/30/2001	55	75	1	12	25	4	0	0	3	175	0	0	0	0
10/31/2001	127	112	3	50	29	3	-1	0	24	347	0	0	0	0
11/1/2001	38	35	0	4	7	5	-1	-1	140	227	0	0	0	0
11/2/2001	79	63	2	40	22	8	5	0	7	226	0	0	0	0
11/3/2001	28	26	0	23	12	3	1	0	8	101	0	0	0	0
11/4/2001	29	33	1	18	17	1	0	0	1	100	0	0	0	0
11/5/2001	14	16	0	8	10	1	4	1	1	55	0	0	0	0
11/6/2001	180	143	0	63	19	0	0	0	31	436	0	0	0	0
11/7/2001	187	155	0	61	23	0	0	0	0	426	0	0	0	0
11/8/2001	48	11	0	3	1	0	0	0	0	63	0	0	0	0
11/9/2001	21	11	0	0	0	0	0	0	310	342	0	0	0	0
11/10/2001	22	12	0	0	0	0	0	0	393	427	0	0	0	0
11/11/2001	29	11	0	0	0	0	0	0	380	420	0	0	0	0
11/12/2001	22	21	0	3	1	0	0	0	366	413	0	0	0	0
11/13/2001	61	55	0	12	3	0	0	0	442	573	0	0	0	0
11/14/2001	22	18	0	0	1	0	0	1	552	594	0	0	0	0
11/15/2001	18	23	0	0	0	0	0	0	234	275	0	0	0	0
11/16/2001	32	37	0	1	0	0	0	0	186	256	0	0	0	0

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

August 13, 2001-July 31, 2001.

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
11/17/2001	53	55	0	18	6	0	0	0	0	132	0	0	0	0
11/18/2001	30	42	0	10	6	0	0	0	39	127	1	0	0	1
11/19/2001	14	18	0	4	5	0	0	0	85	126	0	1	0	1
11/20/2001	44	33	0	10	3	0	0	0	0	90	1	0	0	1
11/21/2001	32	55	0	14	8	0	1	0	0	110	0	0	0	0
11/22/2001	74	72	0	19	6	0	0	0	0	171	0	0	0	0
11/23/2001	27	60	0	16	3	0	0	0	0	106	0	0	0	0
11/24/2001	36	50	0	0	0	0	0	0	0	86	0	0	0	0
11/25/2001	38	73	0	3	1	0	0	0	0	115	0	0	0	0
11/26/2001	47	69	0	17	15	1	0	0	0	149	0	1	0	1
11/27/2001	21	19	0	7	7	0	0	0	1	55	0	1	0	1
11/28/2001	19	23	0	9	9	0	0	0	0	60	0	0	0	0
11/29/2001	29	44	0	3	2	0	0	0	0	78	0	0	0	0
11/30/2001	23	53	0	5	1	0	0	0	0	82	0	0	0	0
12/1/2001	18	13	0	1	1	0	0	0	0	33	1	0	0	1
12/2/2001	13	27	0	1	0	0	0	0	0	41	0	0	0	0
12/3/2001	5	9	0	5	0	0	0	0	0	19	0	1	0	1
12/4/2001	3	5	0	0	2	0	0	0	0	10	0	0	0	0
12/5/2001	7	6	0	0	0	0	0	0	0	13	0	0	0	0
12/6/2001	1	6	0	0	0	0	0	0	1	8	0	0	0	0
12/7/2001	11	22	0	3	3	0	0	0	-2	37	1	1	0	2
12/8/2001	2	8	0	3	10	0	0	-1	0	22	0	1	0	1
12/9/2001	2	3	0	1	3	0	0	0	9	18	0	0	0	0
12/10/2001	4	6	0	1	0	0	0	0	7	18	0	0	0	0
12/11/2001	4	8	0	0	3	0	0	0	3	18	0	1	0	1
12/12/2001	1	3	0	1	3	0	0	0	0	8	0	2	0	2
12/13/2001	3	2	0	1	3	0	0	0	0	9	0	1	0	1
12/14/2001	0	5	0	0	0	1	0	0	0	6	0	-1	0	-1
12/15/2001	4	1	0	0	3	0	0	0	0	8	0	3	0	3
12/16/2001	0	2	0	0	3	0	0	0	0	5	0	2	0	2
12/17/2001	2	1	0	1	1	0	0	0	0	5	0	4	0	4
12/18/2001	1	1	0	1	1	0	0	0	0	4	0	0	0	0

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

August 13, 2001-July 31, 2001.

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
12/19/2001	4	2	0	0	0	0	0	0	0	6	0	0	0	0
12/20/2001	0	2	0	0	0	0	0	0	0	2	0	0	0	0
12/21/2001	0	4	0	0	0	0	0	0	0	4	0	0	0	0
12/22/2001	0	1	0	0	0	0	0	0	1	2	0	0	0	0
12/23/2001	1	0	0	0	0	0	0	0	1	2	0	0	0	0
12/24/2001	0	0	0	0	0	0	0	0	0	0	0	1	0	1
12/25/2001	0	0	0	0	0	0	0	0	0	0	1	0	0	1
12/26/2001	2	1	0	0	0	0	0	0	0	3	0	0	0	0
12/27/2001	1	0	0	0	0	0	0	0	0	1	0	0	0	0
12/28/2001	0	1	0	0	0	0	0	0	0	1	0	-1	0	-1
12/29/2001	0	2	0	0	0	0	0	0	0	2	1	1	0	2
12/30/2001	2	3	0	1	0	0	0	0	0	6	0	0	0	0
12/31/2001	1	1	0	0	0	0	0	0	0	2	2	0	0	2
1/1/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2/2002	1	0	0	0	0	0	0	0	0	1	0	1	0	1
1/3/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
1/4/2002	0	0	0	0	0	0	0	0	0	0	1	0	0	1
1/5/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/6/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/7/2002	4	0	0	0	0	0	0	0	0	4	1	0	0	1
1/8/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
1/9/2002	0	0	0	0	0	0	0	0	0	0	0	1	0	1
1/10/2002	0	2	0	0	0	0	0	0	0	2	0	1	0	1
1/11/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/12/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/13/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/14/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/15/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/16/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/17/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/18/2002	0	0	0	0	0	0	0	0	0	0	1	0	0	1
1/19/2002	0	0	0	0	0	0	0	0	0	0	0	1	0	1

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

August 13, 2001-July 31, 2001.

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
1/20/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/21/2002	0	0	0	0	0	0	0	0	0	0	1	1	0	2
1/22/2002	0	0	0	0	0	0	0	0	0	0	3	-1	0	2
1/23/2002	0	0	0	0	0	0	0	0	0	0	0	1	0	1
1/24/2002	0	1	0	0	0	0	0	0	0	1	1	0	0	1
1/25/2002	0	1	0	0	0	0	0	0	0	1	0	3	0	3
1/26/2002	0	0	0	0	0	0	0	0	0	0	0	3	1	4
1/27/2002	0	0	0	0	0	0	0	-1	0	-1	0	1	0	1
1/28/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/29/2002	0	0	0	0	0	0	0	0	0	0	1	1	0	2
1/30/2002	0	0	0	0	0	0	0	0	0	0	0	-1	0	-1
1/31/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/1/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/2/2002	0	0	0	0	0	0	0	0	0	0	1	1	0	2
2/3/2002	0	0	0	0	0	0	0	0	0	0	0	3	0	3
2/4/2002	0	0	0	0	0	0	0	0	0	0	0	1	0	1
2/5/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/6/2002	0	0	0	0	0	0	0	0	0	0	0	3	0	3
2/7/2002	0	0	0	0	0	0	0	0	0	0	3	1	0	4
2/8/2002	0	0	0	0	0	0	0	0	0	0	0	1	0	1
2/9/2002	0	0	0	0	0	0	0	0	0	0	1	0	0	1
2/10/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/11/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/12/2002	0	0	0	0	0	0	0	0	0	0	0	1	1	2
2/13/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/14/2002	0	0	0	0	0	0	0	0	0	0	0	0	3	3
2/15/2002	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2/16/2002	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-2
2/17/2002	0	0	0	0	0	0	0	0	0	0	0	2	0	2
2/18/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
2/19/2002	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2/20/2002	0	0	0	0	0	0	0	0	0	0	0	1	1	2

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

August 13, 2001-July 31, 2001.

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
4/25/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/26/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/27/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/28/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/29/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/30/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/1/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/2/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/3/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/4/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/5/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/6/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/7/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/8/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
5/9/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/10/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/11/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/12/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/13/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/14/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/15/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/16/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/17/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/18/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/19/2002	0	0	1	0	0	0	0	0	0	1	0	0	0	0
5/20/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
5/21/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
5/22/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
5/24/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/25/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/26/2002	0	0	1	0	0	0	0	0	0	1	0	0	0	0

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

August 13, 2001-July 31, 2001.

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
5/27/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
5/28/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/29/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
5/30/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
5/31/2002	1	1	0	0	0	0	0	0	0	2	0	0	0	0
6/1/2002	1	4	0	0	0	0	0	0	0	5	0	0	0	0
6/2/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/3/2002	0	1	0	0	1	0	0	0	0	2	0	0	0	0
6/4/2002	0	2	0	0	0	0	0	0	0	2	0	0	0	0
6/5/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/6/2002	2	2	1	0	0	0	0	0	0	5	0	0	0	0
6/7/2002	2	5	0	0	1	0	0	0	0	8	0	0	0	0
6/8/2002	3	3	1	0	0	0	0	0	0	7	0	0	0	0
6/9/2002	1	2	1	0	0	1	0	0	0	5	0	0	0	0
6/10/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/11/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
6/12/2002	2	4	0	0	0	0	0	0	0	6	0	0	0	0
6/13/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
6/14/2002	0	4	1	0	1	0	0	0	0	6	0	0	0	0
6/15/2002	2	4	0	0	0	0	0	0	0	6	0	0	0	0
6/16/2002	1	5	1	0	0	0	0	0	0	7	0	0	0	0
6/17/2002	1	1	0	0	0	0	0	0	0	2	0	0	0	0
6/18/2002	1	0	0	0	0	0	0	0	0	1	0	0	0	0
6/19/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
6/20/2002	3	4	0	0	0	0	0	0	0	7	0	0	0	0
6/21/2002	2	1	0	0	0	0	0	0	0	3	0	0	0	0
6/22/2002	2	1	0	0	0	0	0	0	0	3	0	0	0	0
6/23/2002	1	4	0	0	0	0	0	0	0	5	0	0	0	0
6/24/2002	1	1	0	0	0	0	0	0	0	2	0	0	0	0
6/25/2002	0	2	0	0	0	0	0	0	0	2	0	0	0	0
6/26/2002	0	4	0	0	0	0	0	0	0	4	0	0	0	0
6/27/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
6/28/2002	1	1	0	0	0	0	0	0	0	2	0	0	0	0
6/29/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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

August 13, 2001-July 31, 2001.

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
6/30/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/2/2002	3	0	0	0	2	0	0	0	0	5	0	0	0	0
7/3/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/5/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10/2002	0	1	0	0	0	0	0	0	0	1	0	0	0	0
7/11/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/14/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/15/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/16/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/19/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/20/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/21/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/22/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/23/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/24/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/25/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/26/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/27/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/29/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/30/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/31/2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	1885	2019	14	589	394	31	10	-1	3287	8228	25	52	14	91